GENERATION, TRANSMISSION AND APPLICATION OF THE POWER SERVICES

SUPERPRESSURE PUMPS • 71

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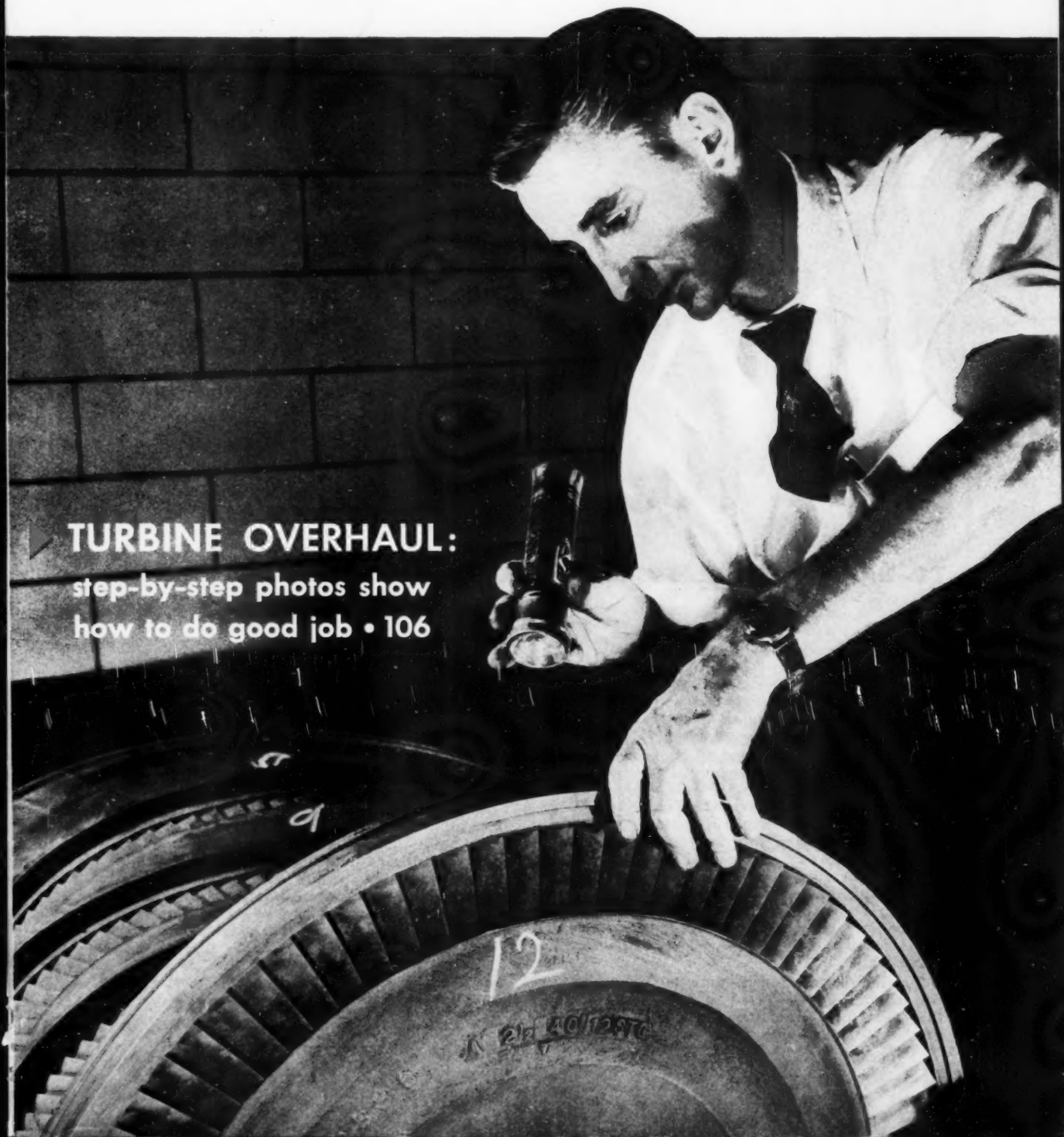
TRAINING OPERATORS • 103

Power

November
1953•50¢

A McGRAW-HILL PUBLICATION



TURBINE OVERHAUL:

step-by-step photos show how to do good job • 106

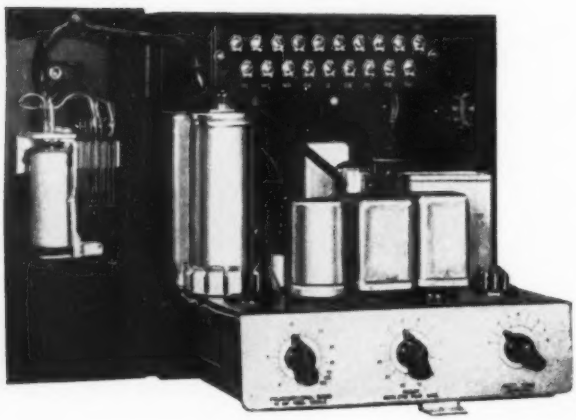
Jrl. Ad ND45-33A-453(1)

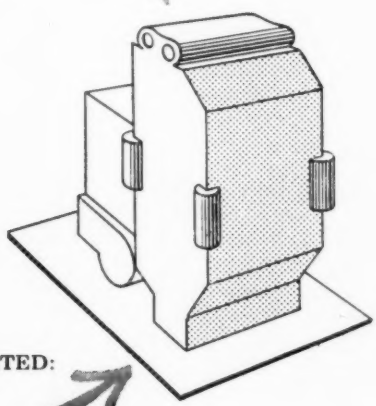
CONTROL ACTIONS:

- *Proportional Action*
- *Reset Action*
- *Rate Action*
- *Anticipatory Action from changes in combustion rate*

CONTROLLING QUANTITY OR FUNCTIONS:

- *Superheat Temperature*
- *Reheat Temperature*
- *Sum or Difference of Superheat and Reheat Temperature*





EQUIPMENT ACTUATED:

- *Desuperheating valves*
- *By-pass dampers*
- *Tilting burners*
- *Gas recirculation dampers*
- *Proportioning dampers*
- *Condenser valves*

THIS ELECTRONIC CONTROLLER HAS THE flexibility TO HANDLE YOUR SUPERHEAT-REHEAT CONTROL PROBLEMS

Here is a controller which looks at superheat temperature, reheat temperature or any of their combinations—electronically "computes" the proper control action—and applies it to the correct actuator or group of actuators.

This flexibility of control is vitally important in regulating today's critical superheat-reheat temperatures. Your boiler may employ dampers, tilting burners or valves, separately or in combinations, each having its individual control characteristics. In many steam generators a single actuator affects both superheat and reheat temperatures over part of the load range. As load and furnace conditions require the control to regulate different actuators or groups of actuators, the *control actions* as well as the *controlling quantity or function*—superheat, reheat, or the sum or difference of these temperatures—must be varied accordingly.

The built-in electronic intelligence of the L&N Series '50 Controller enables it to consider all these variables simultaneously. This controller has been supplied with as many as four separate groups of *control actions*—proportional, reset, rate and anticipatory—to meet individual control needs.

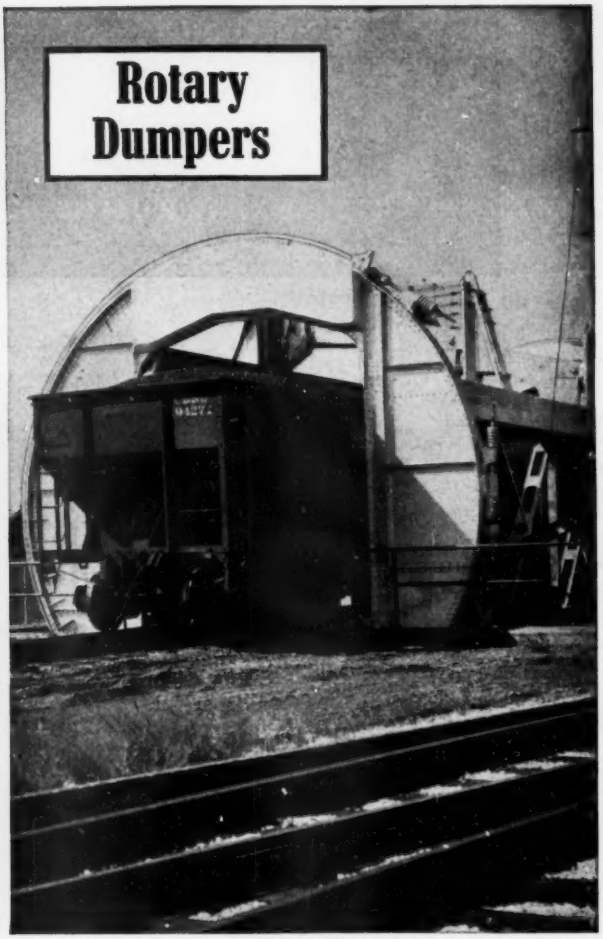
Inherent self-balancing permits rapid automatic transfer from one actuator to another, while introducing a completely new set of control actions, as well as a different control quantity or function.

Inherent flexibility of the Series '50 Controller allows the complete superheat-reheat control system to guard against interaction of the two steam temperature controls and to provide the close temperature regulation your boiler requires.

If you're thinking of tomorrow's—as well as today's—superheat-reheat control problems, why not look to L&N—the only instrument company offering integrated controls for *both* steam and electrical generation. Write Leeds & Northrup Co., 4910 Stenton Avenue, Philadelphia 44, Pa.

LEEDS & NORTHRUP
instruments — automatic controls • furnaces

EASIER ON CARS with minimum noise level . . . thanks to exclusive low-frequency vibration. The Link-Belt Car Shaker helps hopper cars empty themselves. Even hard-packed loads come "broom clean" in a matter of minutes. Especially good for damp, sticky materials. Write for Book 2345.



BOTTOMS UP . . . empties 90-ton car every 60 seconds or less (including return to upright position) by simply turning car upside down. Simple, automatic, foolproof. Takes all open-type cars—any length, width or height . . . up to 90-ton or 120-ton capacity. Book 2048-A has complete data.

Railroad cars come clean . . . in as little as 60 seconds or less!

For fast, safe, push-button car unloading . . . at substantial savings — choose Link-Belt equipment

IF you empty a few gondola cars a day—or several thousand a week, Link-Belt makes the right railroad car unloader for your particular requirements. Only Link-Belt builds both types—the automatic Rotary Car Dumper for large users . . . the low-frequency Car Shaker for smaller operations.

Both are precision engineered to reduce unloading hazards, minimize injury possibilities, cut costly demurrage charges.

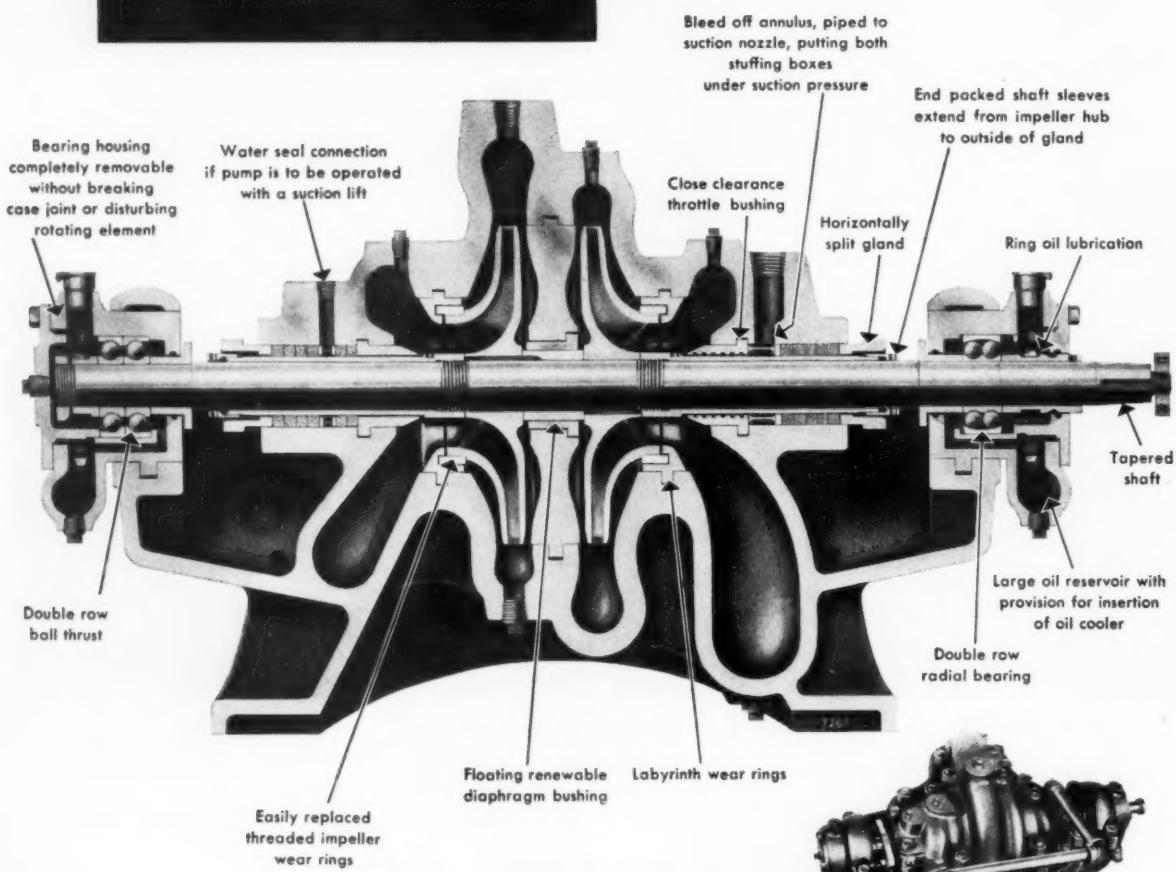
Yes, if your operations require rapid railroad car unloading of any bulk material, it will pay you to call your nearest Link-Belt representative. He'll give you an unbiased recommendation for the right type of equipment for your needs.

LINK-BELT

CAR SHAKERS and ROTARY DUMPERS

LINK-BELT COMPANY: Plants: Chicago, Indianapolis, Philadelphia, Colmar, Pa., Atlanta, Houston, Minneapolis, San Francisco, Los Angeles, Seattle, Toronto, Springs (South Africa), Sydney (Australia). Sales Offices in Principal Cities. 13,203

DE LAVAL
TWO-STAGE
HORIZONTAL PUMPS


Bleed off annulus, piped to suction nozzle, putting both stuffing boxes under suction pressure
End packed shaft sleeves extend from impeller hub to outside of gland
Bearing housing completely removable without breaking case joint or disturbing rotating element
Water seal connection if pump is to be operated with a suction lift
Close clearance throttle bushing
Horizontally split gland
Ring oil lubrication
Tapered shaft
Double row ball thrust
Large oil reservoir with provision for insertion of oil cooler
Double row radial bearing
Floating renewable diaphragm bushing
Labyrinth wear rings
Easily replaced threaded impeller wear rings

These 14 Design Features Insure Long-range, Low-cost Service

Look at the important design features highlighted in this cross-section. You will clearly see why De Laval 2IS-2KS Two-Stage Horizontal Pumps are designed to give you long, dependable, highly efficient service. ● These pumps are precision-made to quality manufacturing standards. They are available in capacities from 75 to 3,000 gpm, sizes from 2″ to 8″ discharge and heads to 750 feet. Write for Bulletin 1501 giving complete data.

DE LAVAL *Centrifugal Pumps*

DE LAVAL STEAM TURBINE COMPANY

815 Nottingham Way, Trenton 2, New Jersey

DL-2259

Power

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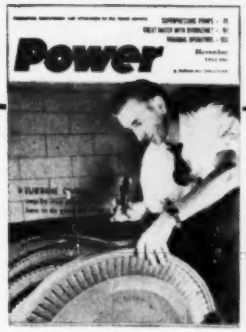

TURBINE OVERHAUL, like many another key maintenance operation, is often discussed but rarely pictured. That's why Associate Editor Steve Elonka was so pleased when he was able to enlist the cooperation of John Wolf, chief engineer of F & M Schaefer Brewing Co, for a photo record of a job on one of their turbines. Chris Grube, McGraw-Hill photographer, did the "shooting," with John Nussbaum, first assistant engineer, helping him get the photos he wanted.

The result of some pretty strenuous activity by all concerned appears on the cover and in the article beginning on p 106. There you see key pictures from the many actually taken, arranged in a meaningful sequence with pithy captions—all for the purpose of telling you more about a turbine overhaul than words alone could ever tell.

Next month . . .

■ Fuel handling and storage appear deceptively simple. There's no complex theory, but for good results you need plenty of judgment in selecting a system from among the many possible arrangements of a vast array of equipment designs. To make this job easier is the aim of our December "special."

■ This handbook outlines clearly the basic functions of handling and storage, rounds up for you the tools of the job. It covers fuel oil and gas as well as coal and other solid fuels.

■ Reader reports show top interest in Paul Brindisi's June article on water treatment for packaged firetube boilers. So you'll be glad to know December will carry a companion piece on conditioning water for packaged boilers of the watertube type.

■ Want to get more and better work from your maintenance crews? A Pennsylvania utility has some novel answers; an upcoming story spills them.

. . . and future months

■ This issue carries the second of a Phil Swain "Headwork" series giving the low-down on high-pressure steam, and we really mean high—well above the critical. Watch for other stimulating articles by top authorities on superpressure problems and promises.

The RIGHT DRAFT for Any Combustion Condition

...Stepless, Wide Range Speed Control of Direct Coupled Draft Fans

When Type 257 Liquid Rheostats control the speed of boiler fans driven by wound rotor motors you get:

- Immediate response to varying draft conditions.
- Smooth, continuous, *stepless* speed control.
- Equal sensitivity over the entire operating range.

HOW IT WORKS. Motor speed is varied by increasing and decreasing resistance. This is accomplished by raising and lowering electrodes and the level of current-carrying electrolyte. A pilot device transmits draft condition to a lifting mechanism which controls electrode position and electrolyte level. A full resistance range is provided in only 10 inches of electrode travel. The basic principle of liquid rheostat operation plus the utilization of specially engineered electrodes gives a linear relationship between motor speed and electrode travel over the complete rheostat range.

Since the rheostat is not mechanically connected to the motor it may be located to suit the most convenient plant layout. For complete details, contact your Allis-Chalmers representative or write for leaflet 14S7544. A-4066

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Milwaukee 1, Wisconsin

Power

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...with Power readers...

WANT POWER VOLUMES?

Often I notice someone asking to get back issues of POWER. I have every issue from 1930 up to date. The 1930 to 1936 issues were condensed recently and made into one volume exclusive of most advertising. The 50-year June issue, 1934, is intact. The 1936, 1937, 1938 and 1939 issues have all advertising removed. From 1940 on, the January and December issues are intact, being used for the outside binders of the ten issues which have most of the advertising removed. Condensed as they are, the volumes are 5 ft wide.

Salem, Oregon — H R RILEY

If you're interested in filling out missing sets of POWER, *and want to purchase volumes from reader Riley, you can reach him directly at Route 5, Box 404, or you can write to us and we'll forward your offer to him at Salem, Oregon.*—ED.

THOSE BEGINNINGS . . .

Sorry I can't be of any help in locating copies of *Steam*, as you requested in August POWER, but just to be contrary if nothing else, I thought I'd drop you a line on the subject anyhow.

Under the heading "Are we older than we thought?" you say that all indications point to the year 1880 as the starting date

(*Continued on page 222*)

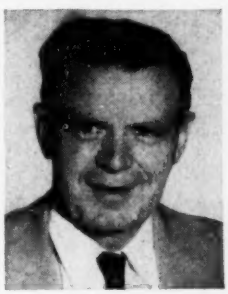
...lines and bylines

J B Sims

ENGINEERING runs in the Sims blood—"JB" who tells about his Grand Haven diesel plant (pp 75-77) has an 83-yr-old engineer father and a son who is electrical engineer for Kalamazoo Vegetable Parchment Co. Betting in the family is that grandson JB III, now one year old, will also grow up in the engineering mold.

Our JB was born and educated in Texas (Texas A&M) but worked for large engineering firms in all corners of the U.S. Now settled firmly in Michigan, he has made the Grand Haven municipal plant widely known for efficient operation and for the economical use of heavy residual fuel oils.

Always interested in aviation, JB helped the editor of his hometown paper build a Bleriot monoplane, flew World War I "Jennys" and still flys—both as a hobby and as a means of getting around the state, where he does consulting work in power engineering.



Hans Gartmann

HIGH-PRESSURE PUMPS are the current concern of Hans Gartmann, as you can tell from his article on pp 71-74. Now chief engineer of DeLaval's centrifugal pump and compressor departments, he has held important design posts with that company since 1924.

Born and educated in Switzerland (Winterthur College, BS in ME, 1923), Gartman began his engineering career as a compressor calculator for Brown Boveri at Baden.

Hans makes a hobby of lawn bowling and enjoys boating and fishing with his children (a boy and a girl) during summer week ends at their cottage at Beach Haven Park, N. J. A member of numerous engineering societies (Naval Architects and Marine Engineers, Naval Engineers), he has served as chairman of the Trenton subsection of ASME (1946-47) and president of the Engineers Club of Trenton (1949-50).

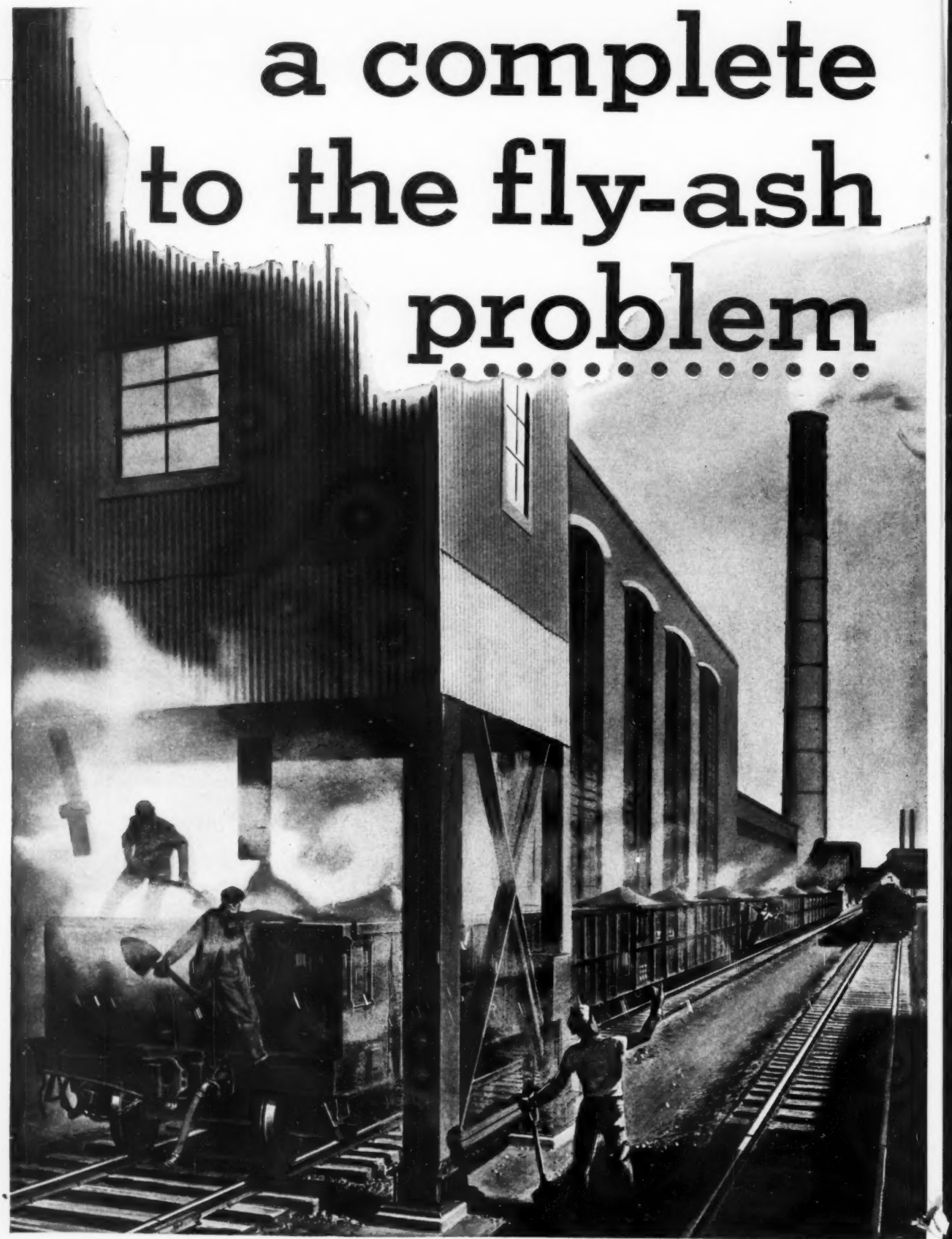
B J Covner

PSYCHOLOGIST with an engineering outlook is Dr B J Covner, author of the article on "human engineering" beginning on p 84. Hailing from Rochester, N. Y., Dr Covner holds degrees from Colgate (AB) University of Pennsylvania (MA) and Ohio State (PhD). His experience includes a wide variety of industrial psychological activities.

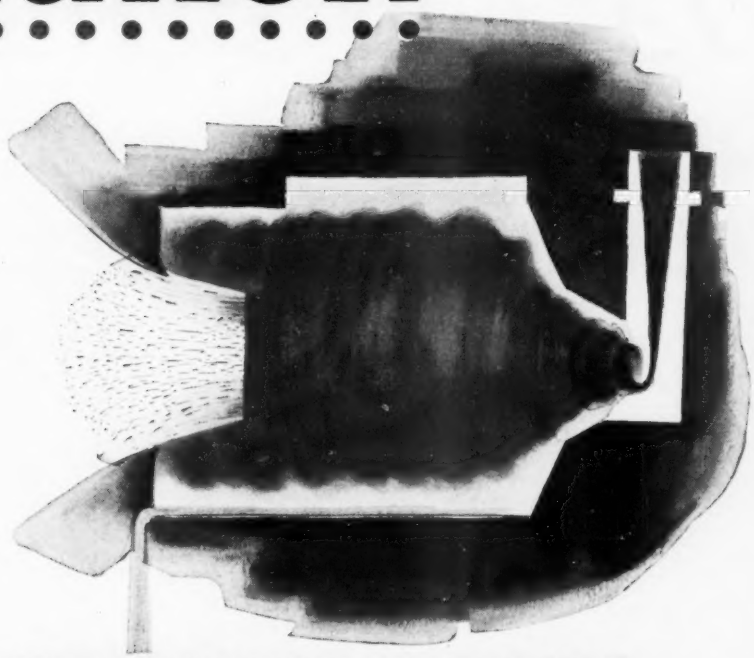
During World War II he was civilian consultant at precommissioning-training engineering school where he built a mock-up boiler and engine room to aid training of naval engineering personnel. His recent work has taken on an additional dimension—how to design engineering equipment for ease, accuracy and safety in operation, what is coming to be called human engineering. In this field, he and his associates have worked with utilities, industrial companies and insurance organizations.

Dr Covner first made acquaintance with electrical equipment as a radio "ham"—was licensed at age 15 and operated W8AWD until World War II. Now likes to write, fish, listen to classical music.

a complete to the fly-ash problem



solution



THE CYCLONE FURNACE

Power-plant operators have been plagued for years by the expense and nuisance caused by fly ash and the community relations problems involved in its disposal. They have spent millions to keep fly-ash from reaching the atmosphere and, yearly, spend many additional millions in handling thousands of tons of troublesome, dusty fly-ash and paying for its removal.

Today, the Cyclone Furnace completely solves this major problem:

1. Most of the ash produced by burning the coal is changed to molten slag in the Cyclone Furnace. This slag is easy to handle, has many uses, and often can be sold, representing an asset rather than a liability. Because there is so little ash in the gas leaving a Cyclone-Furnace-fired boiler, it is often possible to eliminate precipitators. Where precipitators are used, they can be greatly simplified, because the designer can think in terms of pounds—instead of tons—of ash per hour.

2. Where local conditions may require use of precipitators in conjunction with the Cyclone Furnace, there is no need for handling the fly-ash collected. It can, with simple equipment, be blown back into the Cyclone Furnace to be melted down into slag.

Through this one feature alone—by completely solving the fly ash problem—the Cyclone Furnace greatly improves plant operations. But many other advantages, such as increased availability through elimination of outage-causing equipment, simplified operation through use of crushed coal, reduced cost of upkeep, and higher thermal efficiency, also are obtained with Cyclone Furnaces.

Many B&W Cyclone-Furnace-fired boilers are in operation, in various parts of the country, burning many different kinds of coal. The operating requirements and the design conditions for these boilers include most of the variations that can be expected in utility practice. We will be pleased to discuss with you the many ways in which Cyclone Furnace firing can be of benefit to you.

CYCLONE FURNACE BOILER UNITS IN OPERATION

Owner & Station	Number of Boilers	Kilowatt Rating
COMMONWEALTH EDISON		
Calumet	1	18,000
Fisk	2	150,000
Ridgeland	4	300,000
PUBLIC SERVICE CO. OF NORTHERN ILLINOIS		
Waukegan	1	40,000
Waukegan	1	110,000
Joliet	2	107,000
NORTHERN INDIANA PUBLIC SERVICE CO.		
Michigan City	3	105,000
DOW CHEMICAL CO.		
West Side Plant	1	30,000
South Side Plant	2	60,000
WISCONSIN POWER & LIGHT		
Sheboygan	1	60,000
BABCOCK & WILCOX		
Barberton	1	—
JERSEY CENTRAL POWER & LIGHT		
South Amboy	1	62,500
TOTAL UNITS IN OPERATION	20	1,042,500

BABCOCK & WILCOX

BOILER DIVISION

G-610

GIVE Your BOILERS

MODERNIZE YOUR CLEANING PRACTICES . . .

it will SAVE YOU MONEY

ELIMINATE

- Hand lancing—it's costly, inefficient, inadequate
- Shutdowns for cleaning slag deposits
- Load limitations because of slag accumulations
- Load limitations because of temperatures being exceeded
- Waste in fuel due to surface fouling
- Waste in steam by worn or inefficient cleaning devices

INSTALL

- Diamond Model IK long retracting blowers to clean slagged tube banks
  (Send for Bulletin 1080)
- Diamond Model IR short retracting blowers for water-wall cleaning
  (Send for Bulletin 1079)
- Diamond Model G9B rotating steam blowers for tube banks
  (Send for Bulletin 1137)
- Diamond Model A2E rotating air-puff blowers for tube banks
  (Send for Bulletin 1091)
- Diamond mechanized and automatic drives and controls

6541

50th ANNIVERSARY 1903-1953

DIAMOND POWER SPECIALTY

a BREAK . . .

REALIZE

- Higher boiler capacity—mechanical cleaning is uniformly better
- Higher boiler availability—fixed charges are high
- Lower boiler maintenance—cleanliness reduces deterioration
- Higher boiler efficiency—a continual saving in fuel
- Better operating practices—mechanization improves morale

HAVE DIAMOND "SHOW YOU" HOW TO GET RESULTS

Contact nearest representative at:

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BISMARCK
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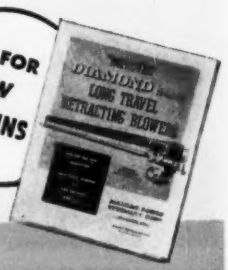
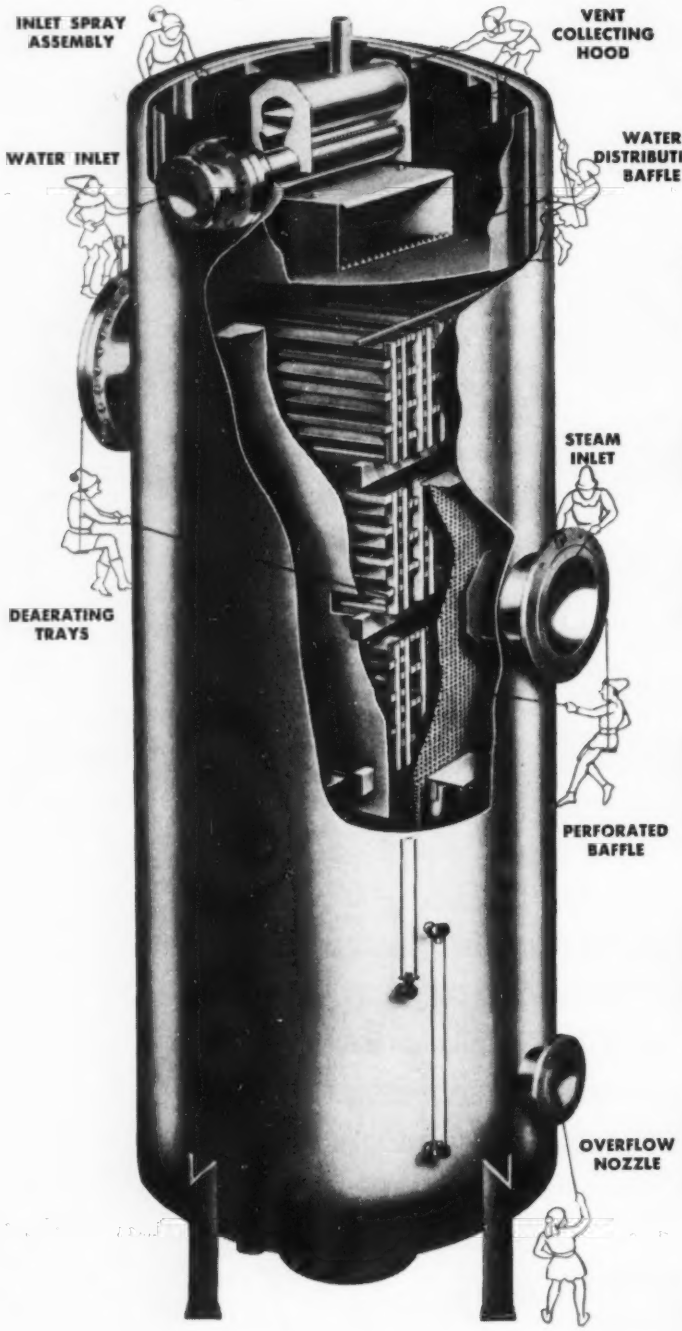
ASK FOR NEW BULLETINS



CORPORATION LANCASTER, OHIO

Diamond Specialty Limited • Windsor, Ontario



They tailor in steel at Elliott for ELLIOTT DEAERATING FEEDWATER HEATERS

An Elliott deaerating heater of multiple tray type. In this latest design the traditional tube-type vent condenser is replaced by a stainless steel vent collecting hood, located inside the shell at top, with the inlet spray assembly just below it. This design saves headroom and requires no maintenance beyond routine inspection.

All through this unit, stainless steel is used wherever there is contact with corrosive water. The trays, formerly of cast iron, are of fabricated stainless steel, light in weight and easily handled.

ELLIOTT

N3-2

DEAERATOR AND

Rolling the shell of a deaerating heater to gage, on a large capacity bending roll.

It reminds one of the Lilliputians making a suit of clothes for the famous Gulliver, to see Elliott welders, bending roll operators and others doing the mammoth tailoring job required in building big Elliott deaerating heaters and their storage tanks.

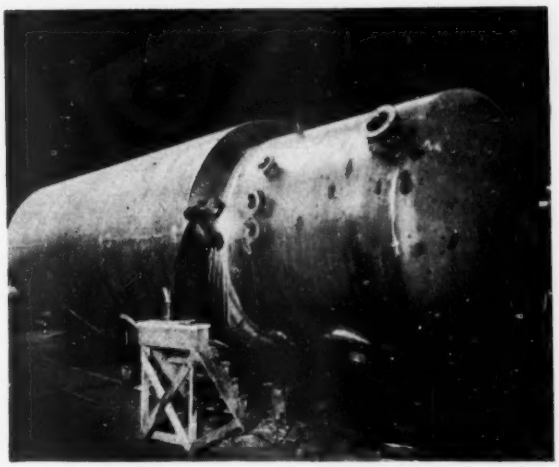
The whole job is done in the Elliott works, assuring no deviation from Elliott quality, no sharing of responsibility with any outside source. When you get an Elliott deaerating heater you know it's *all* Elliott, product of the organization which 35 years ago was first to conceive the process of removing corrosion-causing dissolved oxygen from feedwater, and which pioneered the equipment to do it. With a start like this, Elliott deaerating heaters easily maintain their lead in design for performance and ease of maintenance.

For bulletins and full details on Elliott deaerating heaters, contact your local Elliott representative or district office, or write Elliott Company, Jeannette, Pa.

Company

HEATER DEPARTMENT

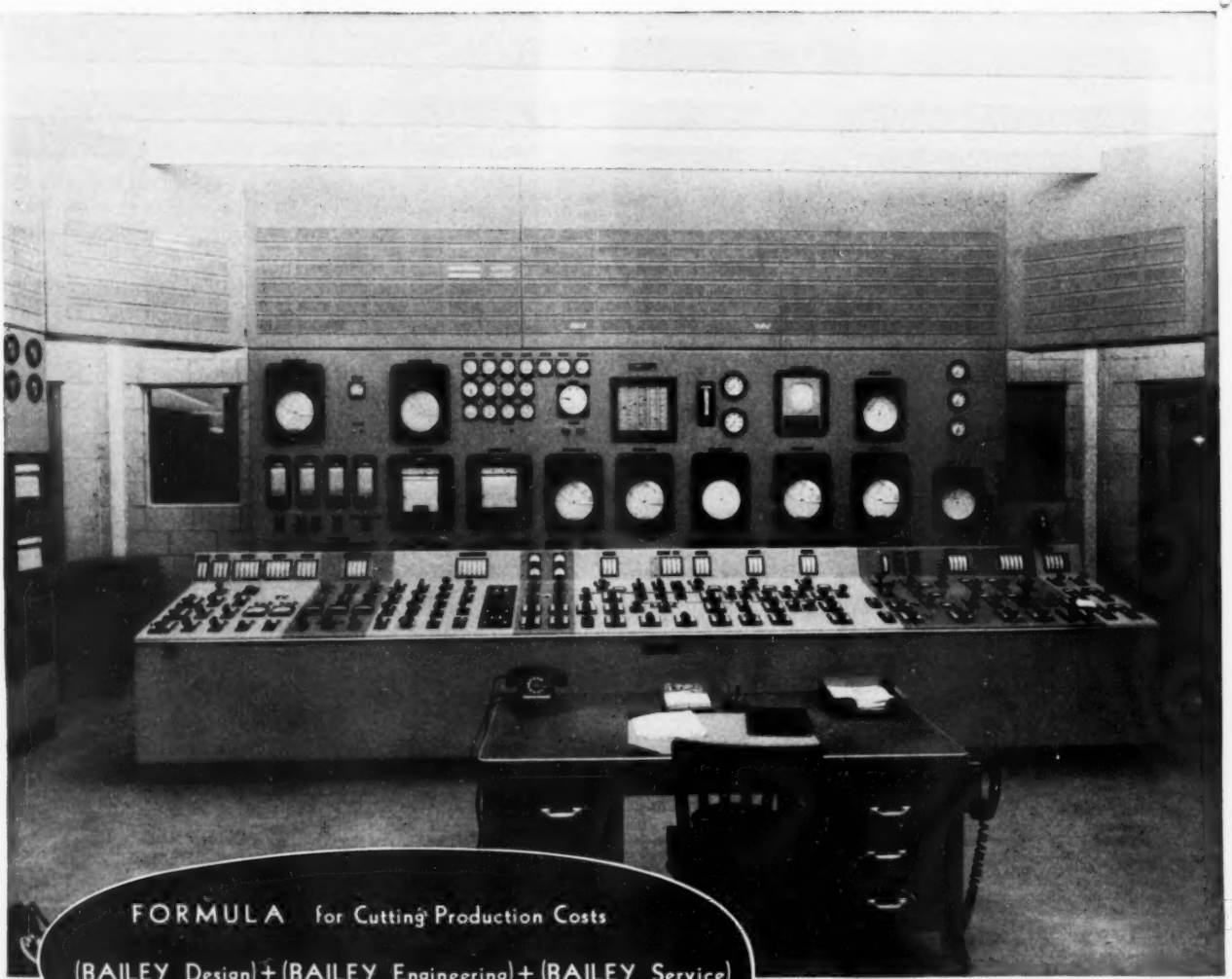
Trimming the edge of a head for a storage tank with an acetylene torch machine. In the background is the shell of a storage tank ready for automatic welding of girth and longitudinal joints.



Welding the bottom of a deaerating heater to the top of its storage tank for vertical installation. All units are built to fit the specific conditions of allowable space as well as of performance required.

Assembly floor in the Elliott welding shop. After assembly, each unit is brought to the test floor for hydrostatic test, then transferred to a flatcar for shipment.

How to Control



FORMULA for Cutting Production Costs

(BAILEY Design) + (BAILEY Engineering) + (BAILEY Service)

= GREATER SAVINGS PER FUEL DOLLAR

Control Center for 125,000 KW reheat boiler-turbine Unit No. 1 at Meramec Station, Union Electic Co. of Missouri. Bailey MINI-LINE Equipment on benchboard gives operators fingertip control while larger recorders on vertical board show operating trends and make permanent records.

Steam Cost

★ Close regulation of fuel and air input is vital to a strict control of your steam cost. But that's not all. You'll need control of other factors, too. Your power costs can be held down only by controlling all of the important operations in your steam plant. That's where you can be sure of help from Bailey Controls. Here's why they can do the job and do it right:

1. Complete Range of Equipment—fully co-ordinated

You need never worry that a Bailey Engineer's recommendation is slanted in favor of a particular type of equipment, as might be the case if he had only a limited line to sell—or that Bailey will pass the buck for efficient control; we offer *complete* boiler control systems.

2. Engineering Service—backed by experience

No other manufacturer of instruments and controls can offer as broad an experience, based on successful installations involving all types of combustion, flow measurement, and automatic control.

3. Direct Sales-Service—conveniently located near you

Bailey Meter Company's Sales-Service Engineers are located in more industrial centers than those of any other manufacturer of boiler control systems; you get prompt, experienced service with a minimum of travel time and expense.

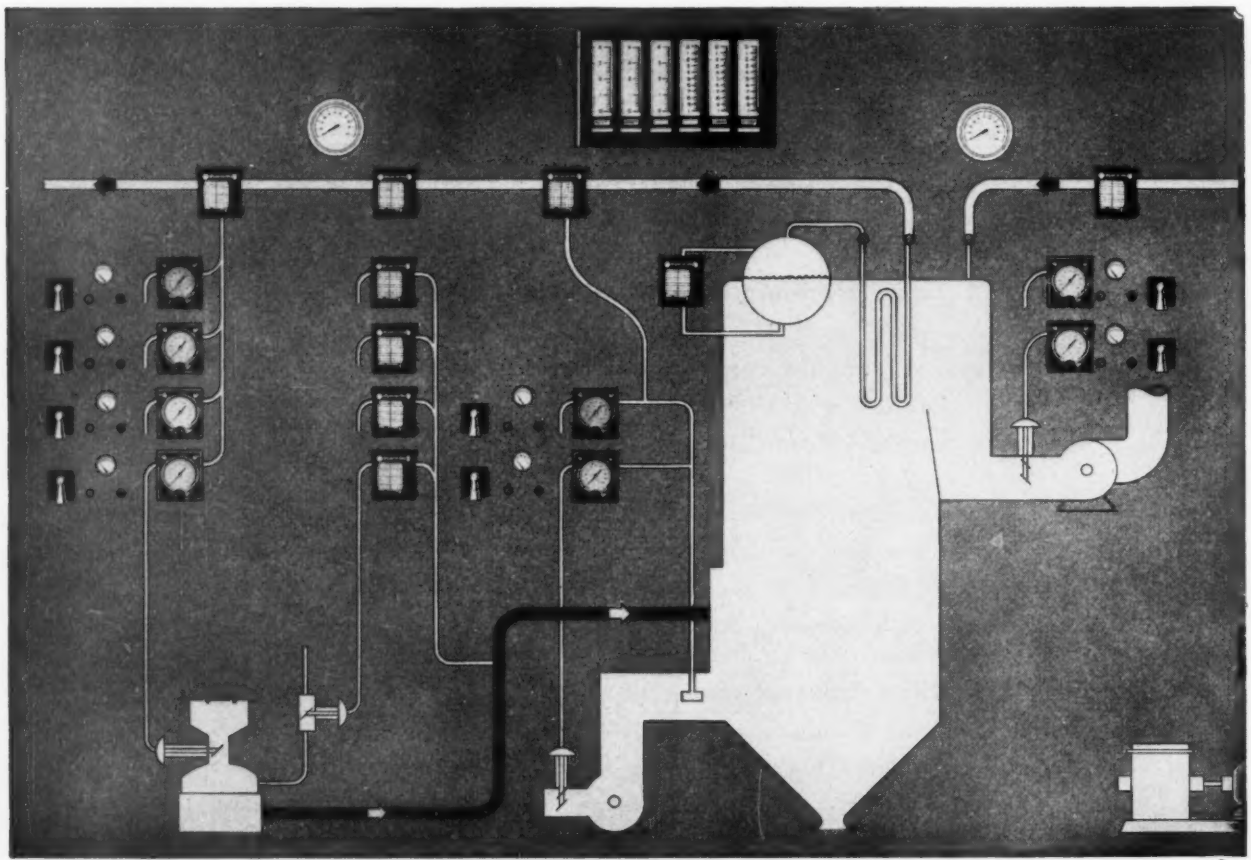
For close control of steam cost, more power per fuel dollar, less outage, and safer working conditions, you owe it to yourself to investigate Bailey Controls. Ask a Bailey Engineer to arrange a visit to a nearby Bailey installation. We're proud to stand on our record: "More Power To You!"

A-120-2

BAILEY
METER COMPANY
1036 IVANHOE ROAD
CLEVELAND 10, OHIO
Complete Controls for Steam Plants

BAILEY METERS
Controls for
COMBUSTION
FEED WATER
TEMPERATURE
PRESSURE
LIQUID LEVEL
FEED PUMPS

TO REDUCE



*

COPES-VULCAN OFFERS ALL THESE CONTROLS

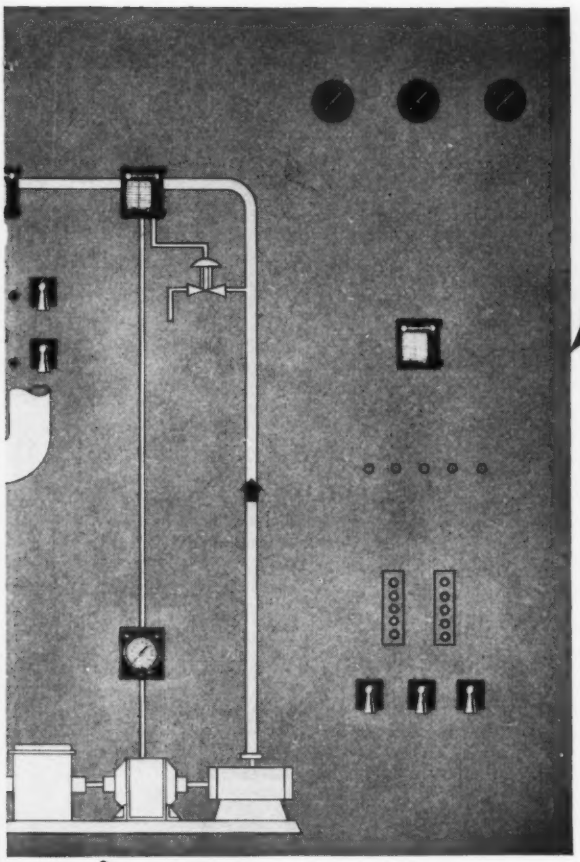
Combustion may be controlled from steam flow-air flow, or by fuel-air-ratio method. Instrumentation of the most modern design by Taylor assures fast response, accurate control and utmost dependability.

Boiler Feed Water may be controlled from three, two or one influences. Feed water control systems may have *instrumentation by Taylor* (Type 3-L, Bulletin 1013), or be electrically or mechanically operated.

Pressure reducing valves to meet any need. Steam temperature control may be from three or two influences, using burner or damper positioning, gas recirculation, direct water spray or heat exchanger.

Full automatic-sequential control may be part of main panel or set up on separate panel. Individual push button control available. For smaller boilers there are manually operated units in several types.

STEAM COSTS



*Modernize With *C·V+T Boiler Control

WHEN you plan to modernize your power facilities, check into the many advantages offered by Copes-Vulcan Boiler Control.

From one dependable source, you can get modern combustion control *with instrumentation by Taylor*, precise feed water control, accurate steam temperature control and automatic cleaning of heat-transfer surfaces.

Remember, too, Copes-Vulcan assumes full responsibility for service wherever needed—for the life of your installation.

Ask Copes-Vulcan engineers for recommendations on how to reduce your steam costs. Write for Bulletin 1007-A.

*C·V+T=BBC

COPES·VULCAN+*Taylor*=BETTER BOILER CONTROL

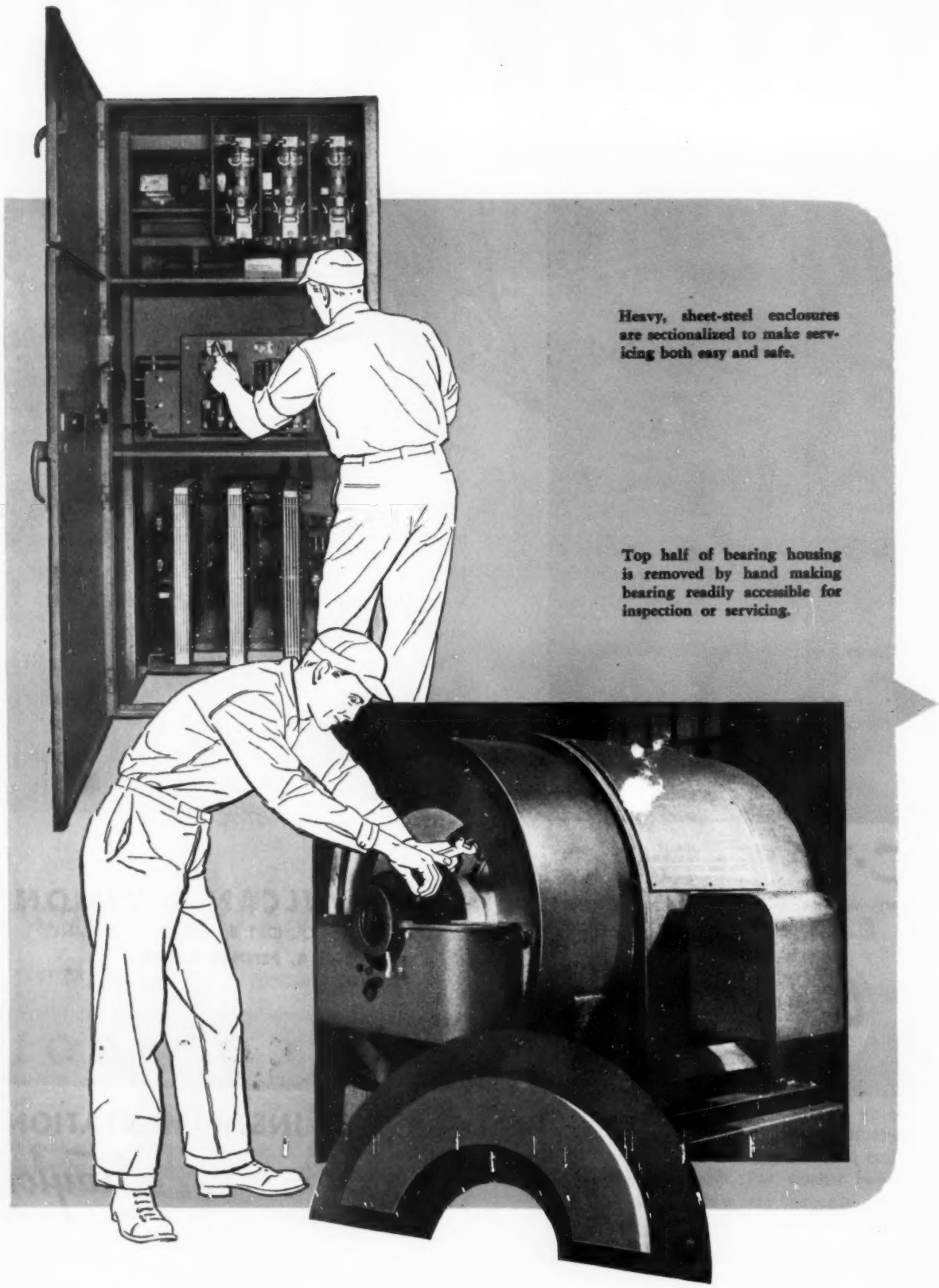
COPES-VULCAN DIVISION

CONTINENTAL FOUNDRY & MACHINE COMPANY

ERIE 4, PENNSYLVANIA

COPES VULCAN BOILER CONTROL

WITH INSTRUMENTATION BY *Taylor*



Heavy, sheet-steel enclosures are sectionalized to make servicing both easy and safe.

Top half of bearing housing is removed by hand making bearing readily accessible for inspection or servicing.

This matched pair reduces servicing time to minutes

Every servicing operation from checking bearings to replacing contacts takes a minimum of time—without the usual muss and fuss—on this motor and control team. All components are functional in design and easy-to-get-at. No special tools are required.

On Westinghouse Large Induction Motors you simply remove the top half of the bearing housing by hand and the bearing is accessible for inspection and servicing. No top bracket to remove—no crane to lift heavy, cumbersome parts. One man and a few minutes is all that it takes.

One man can remove the motor's light, sturdy sectional covers and air shields by hand also. Here again, no crane is required—complete operation can be performed in a matter of minutes.

An occasional look in the door meets most of the servicing requirements on this Westinghouse High-Voltage Starter with air-break contactor. Simple, dependable design assures long mechanical life of the contactor and its moving parts.

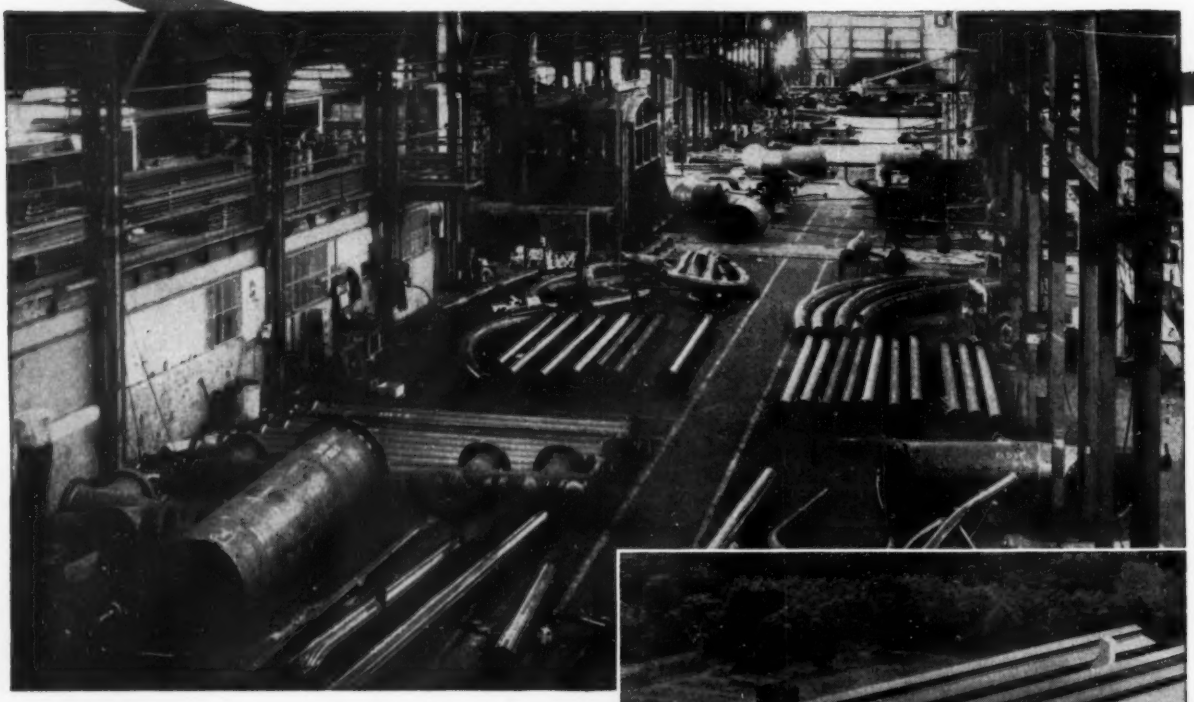
Powerful magnetic blowouts and large arc boxes effectively confine arcs—increase contact life. Built-in fuses are readily accessible . . . easy to install or replace.

Westinghouse Large Induction Motors and High-Voltage Starters are the perfect power partners. Get the benefits of their co-ordinated operation. Call your local Westinghouse representative now for complete details. Or, if you prefer, write to Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-10357-A

YOU CAN BE SURE...IF IT'S

Westinghouse

HERE ARE 2 WAYS DRAVO CAN HELP



1 PIPE FABRICATION SERVICE

Dravo's Pipe Fabricating Shop at Marietta, Ohio is one of the largest and most modern in the industry. It is staffed with qualified personnel (experienced in pipe fabrication) and equipped to offer prompt delivery of the highest grade product, made to your exact specifications.

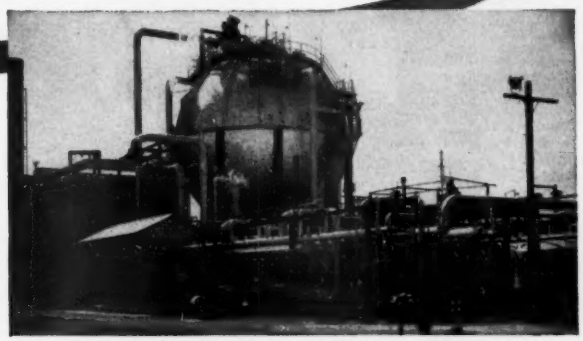
Welding techniques have been perfected by Dravo to permit automatic welding of butt welds and fillet welds of low-alloy and carbon steel materials. X-ray, magna-flux and gamma-ray testing equipment, together with induction stress relieving machines and car-type annealing furnace, are but some of the modern facilities available in this plant. Dravo also has its own chemical and physical laboratories.

Dravo has furnished fabricated piping to major power companies, gas and oil transmission companies, oil refineries, chemical plants and industry in general throughout the United States and abroad.

Dravo's engineers—welding . . . metallurgical . . . design—are available to discuss with you your pipe fabrication problems and requirements.

DRAVO

YOU CUT CONSTRUCTION COSTS!



Dravo fabricated the pipe and erected this complete water treatment plant (with the exception of the large tank shown) for Esso Standard Oil Company at Bayway, New Jersey.

2 COMPLETE INSTALLATIONS

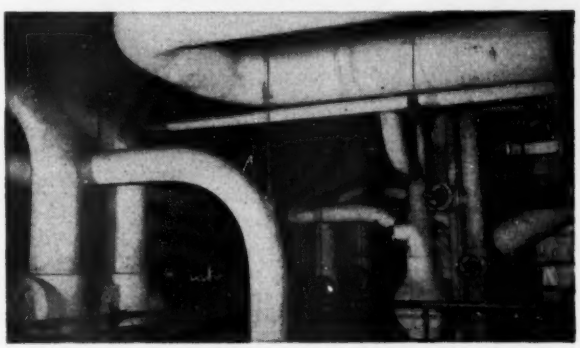
Dravo is prepared to further serve you by being your "Construction Department." Dravo's construction staff, working with your personnel, can erect the piping and mechanical equipment in your plant . . . or can take over the complete project with responsibility for erecting the entire installation from the plans furnished by you.

Dravo is also experienced in handling mechanical construction projects on a "turn-key" basis, providing you with a complete power station . . . boiler plant . . . water pumping station . . . pipe line facility . . . water or waste treatment plant. In such a capacity, Dravo acts as engineering constructors, handling the job through all phases from blueprint stage to the completed project. Many customers have taken advantage of Dravo's 60 years experience in all types of mechanical engineering and construction and have benefited by Dravo's single contract responsibility.

Dravo constructed the new boiler house and furnished and installed this 100,000 cfm DeLaval blast-furnace turbo-blower at the Cleveland Works of Jones & Laughlin Steel Corporation.

ASK FOR MORE INFORMATION

Why not find out today how Dravo can be of service to you? Write or call Dravo and ask to have one of our representatives call on you.



Dravo fabricated and installed the piping for the new Plant Two power house at the Goodyear Tire & Rubber Company, Akron, Ohio.

DRAVO
CORPORATION

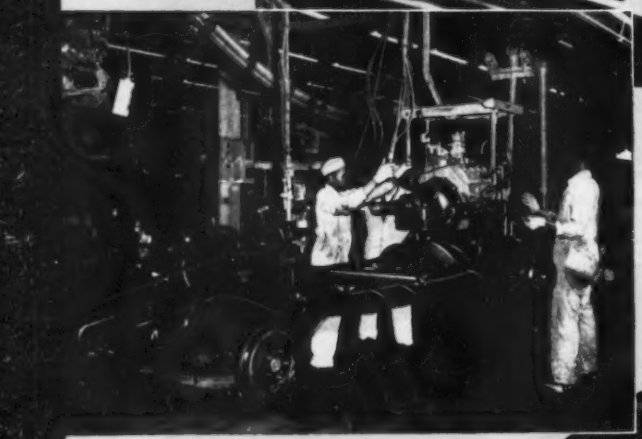
Fifth and Liberty Avenues, Pittsburgh 22, Penna.

CHICAGO • CINCINNATI • CLEVELAND • DETROIT • INDIANAPOLIS • NEW YORK • PHILADELPHIA • PITTSBURGH • ST. LOUIS • WASHINGTON

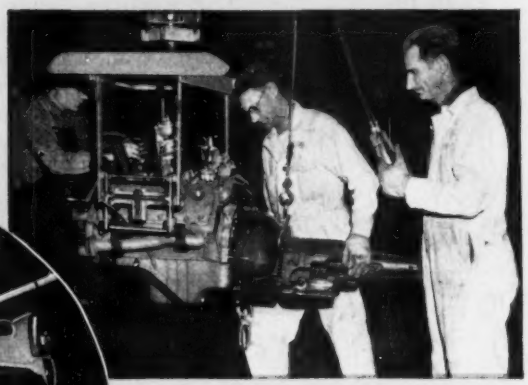
FORD'S *Most Modern*

Above workers in **Cushion Department**

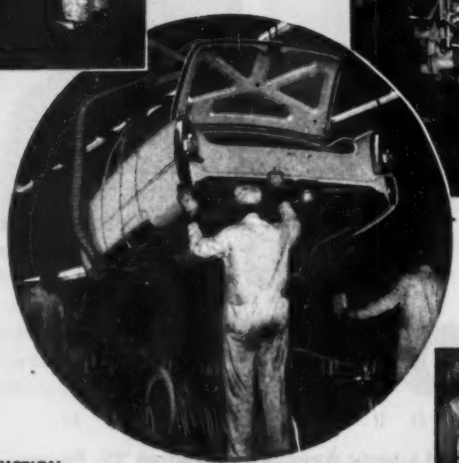
Length of Plant is 1500 feet. Width is 900 feet.



Chassis Line or sometimes called the "Build-up" is the portion of the Assembly Line where the completed engine, brakes, springs and many other items are assembled to the frame.



Motor Line is an example of team work in action. Shown above are three men working on the same engine. One is installing the wiring while the other two are attaching an automatic transmission.



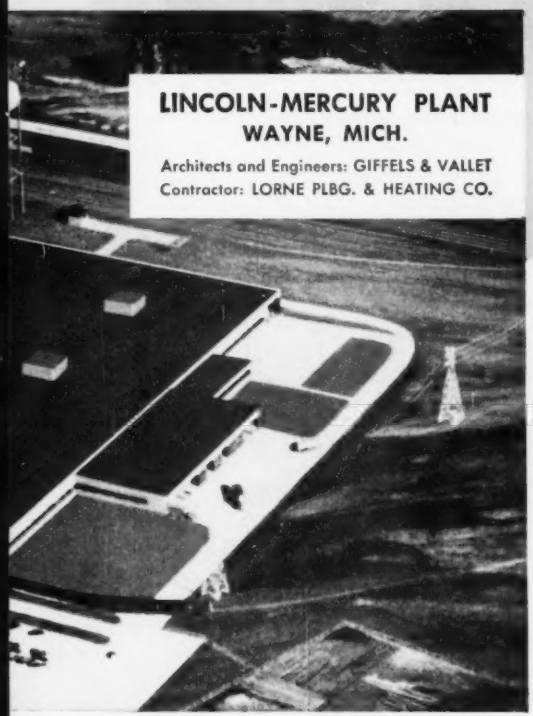
Body Drop (right) is where two assembly lines meet. A trimmed body is lowered on a chassis and becomes the Final Line.

Comfort of employees in the modern **Cafeterias** is assured by Powers Control

POWERS CONTROL

- INCREASES PRODUCTION
- IMPROVES MANY PRODUCTS
- INCREASES OUTPUT OF EMPLOYEES
- REDUCES HEATING COSTS

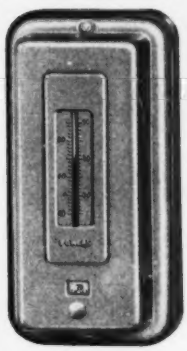
Auto Assembly Plant Equipped with a



LINCOLN-MERCURY PLANT
WAYNE, MICH.
Architects and Engineers: GIFFELS & VALLET
Contractor: LORNE PLBG. & HEATING CO.

POWERS Pneumatic System of TEMPERATURE CONTROL

Comfortable, Even Heat at the Right Temperature for each department helps improve efficiency of employees and results in



- **Increased Production**
- **Better Products**
- **Lower Heating Costs**

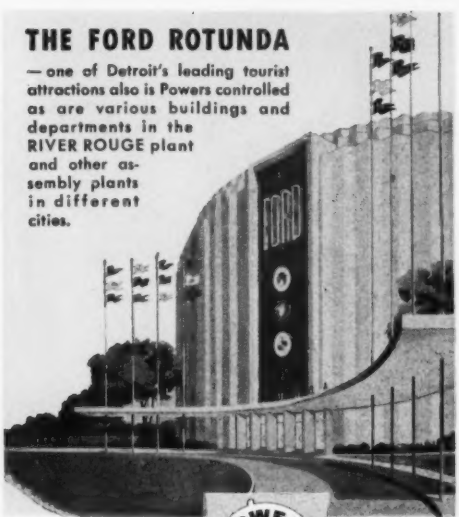
—these are some of the year after year dividends THE FORD MOTOR CO. will receive from its investment in Powers control.

With its almost 1,500,000 square feet of floor space, nine miles of conveyor lines and many advanced features this ultra modern LINCOLN-MERCURY plant is the last word in efficiency. It is a show place among assembly plants.

Into its receiving docks come some 4800 separate parts (with an entire engine as one part). Out of its delivery door, at the rate of 300 cars per 8 hr. day, go completed automobiles tested, checked and ready for driving.

Here a Powers pneumatic control system regulates the steam heating used in the assembly and manufacturing areas and the conditioned air in the paint spray department, first aid and hospital room, cafeterias and administrative offices.

Experience gained by Powers here and in many other important large and small buildings may be helpful to you. When problems of temperature or humidity control arise, contact our nearest office. There's no obligation.

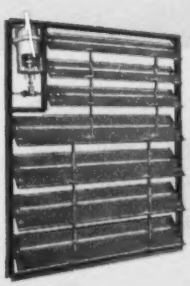


THE FORD ROTUNDA
— one of Detroit's leading tourist attractions also is Powers controlled as are various buildings and departments in the RIVER ROUGE plant and other assembly plants in different cities.

THE POWERS REGULATOR CO.

Since 1891 — SKOKIE, ILLINOIS • Offices in Over 50 Cities • See Your Phone Book

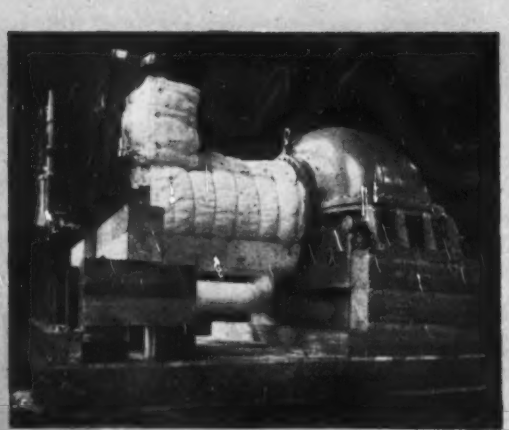
'53 (b27)



POWERS **PACKLESS** VALVES

. . . eliminate packing maintenance, leakage of water or steam, or loss of vacuum.

Another

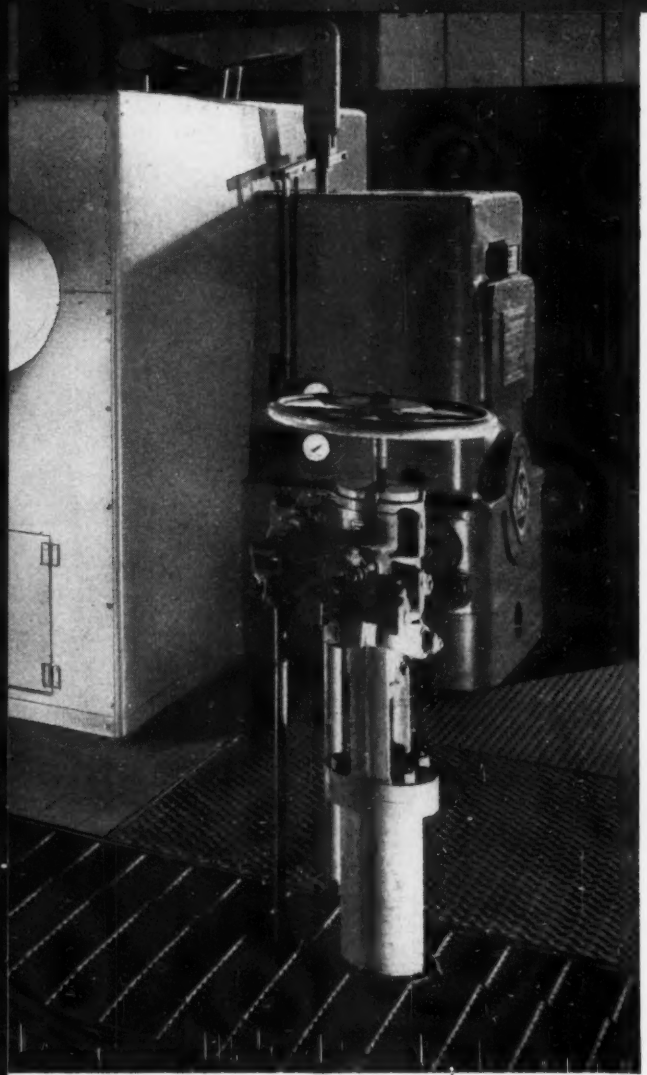


To simplify installation, both turbine and generator are shipped as complete assemblies with rotors locked in place. Turbine insulation is also applied at factory. Illustration at left shows 7500-kw turbine ready to be covered with tarpaulin before shipment.

Attractive appearance of WA-Series turbine and generator is shown above. Unit is rated 7500 kw, with steam conditions of 600 psig, 825 F, 1½ inches mercury absolute. A-C also supplied surface condenser, pumps and motors for this installation.

WA-Series

STEAM TURBINE GENERATOR UNIT



Engineered to Meet Requirements of a Modern Power Plant!

HERE's another Allis-Chalmers WA-Series turbine generator unit with the kind of design features and performance that power producers everywhere are looking for today.

Available for condensing and non-condensing service, the up-to-date WA-Series impulse turbine design is built in sizes 2000 kw and larger in NEMA standard ratings. Basic engineering features include labyrinth steam seals throughout, removable external glands, high chrome alloy steel buckets and nozzles, and time-proved governing system.

Simplicity is Keynote

For ease of installation and maintenance, every detail has been designed to assure maximum simplicity. Three-bearing construction; above-the-floor oil piping; bracket-bearing, housing-type air-cooled generator — all result in a compact unit with simple foundation requirements. And shipment of the turbine and the generator with their rotors in place further minimizes installation costs.

Completely coordinated in design, these modern generating units are manufactured, assembled and tested in one plant under unified supervision.

For a detailed story of the WA-Series features that can help you reduce costs, ask your A-C representative for Bulletin 03B7654, or write to Allis-Chalmers, Milwaukee 1, Wis.

A-4112

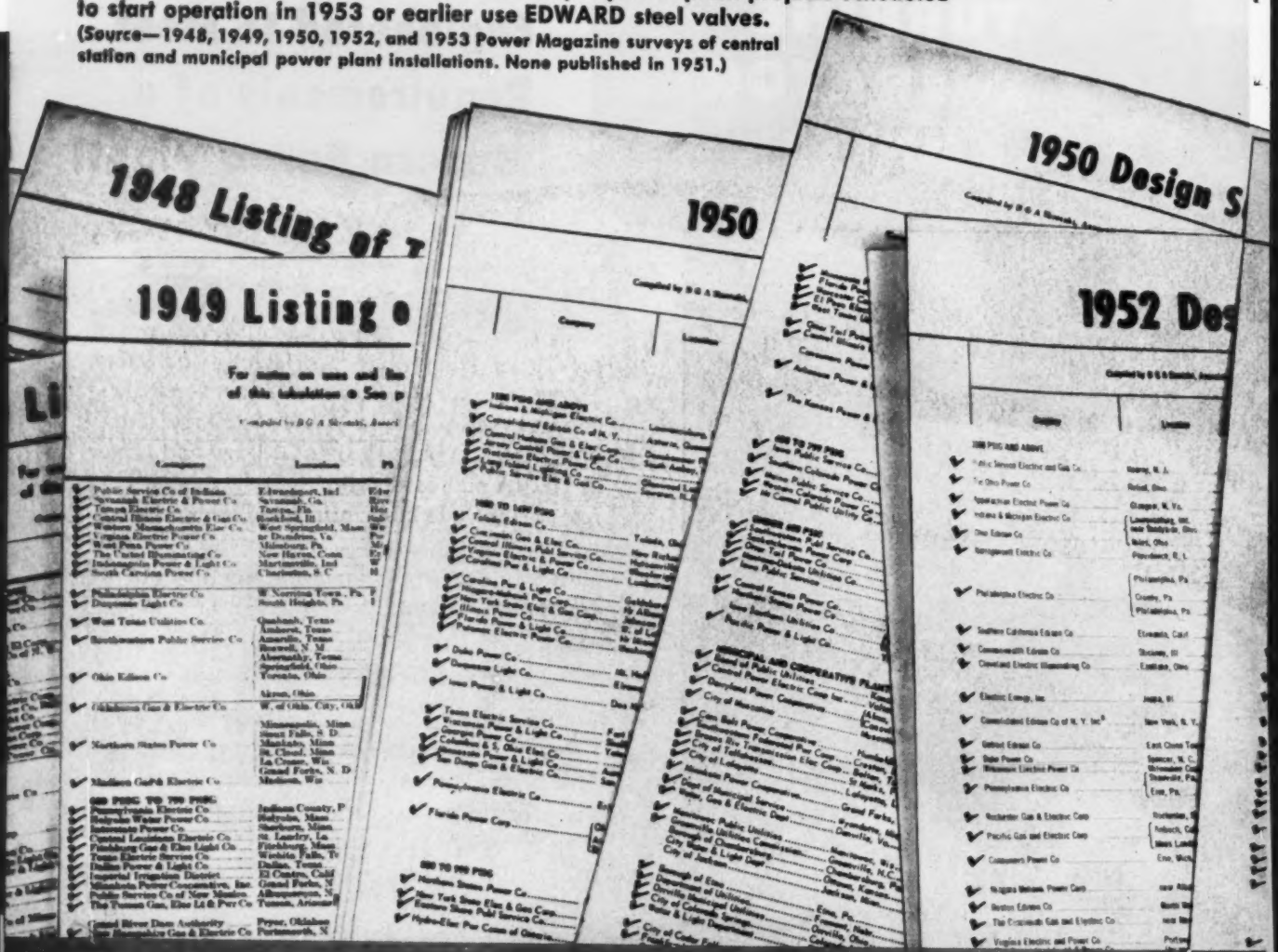
ALLIS-CHALMERS

A-C ALLIS-CHALMERS

Again it's Edward Valves in over

THE EVIDENCE: **575 out of 598 (96.15%) of new central station and municipal power plant projects scheduled to start operation in 1953 or earlier use EDWARD steel valves.**

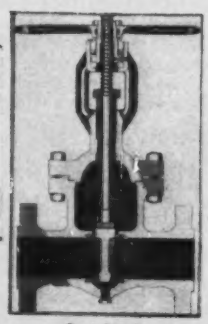
(Source—1948, 1949, 1950, 1952, and 1953 Power Magazine surveys of central station and municipal power plant installations. None published in 1951.)



TYPICAL EDWARD DESIGNS GOING INTO NEW STATIONS

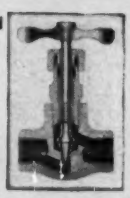
Cast Steel Non-Return

Cast Steel Stop



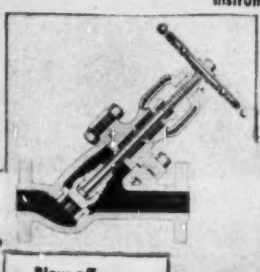
Cast Steel Gate

Cast Steel Check



Forged Gage

Forged Stop



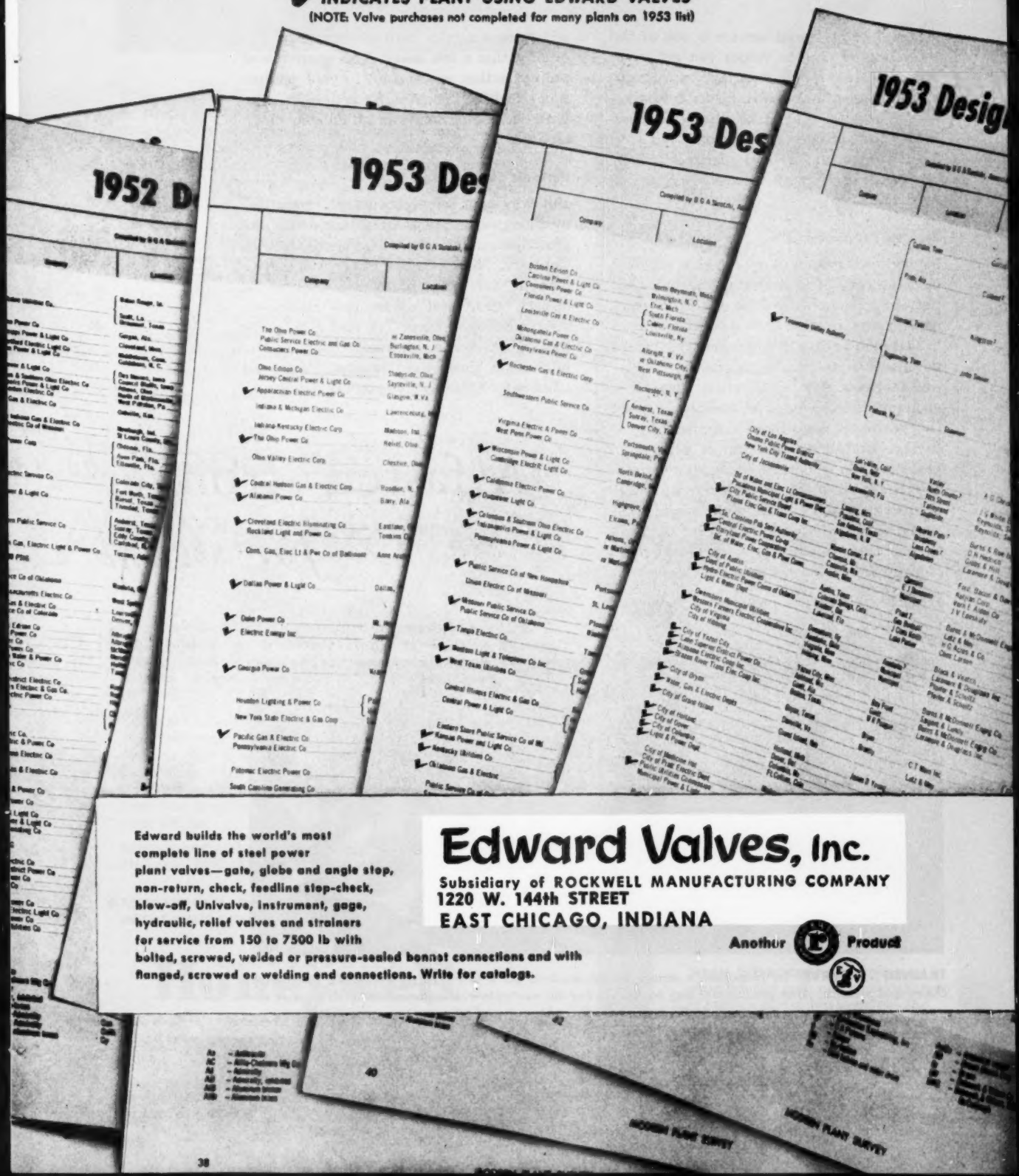
Blow-off

Forged Instrument

Forged Univalves

96% of new power plant projects

✔ INDICATES PLANT USING EDWARD VALVES
(NOTE: Valve purchases not completed for many plants on 1953 list)



Edward builds the world's most complete line of steel power plant valves—gate, globe and angle stop, non-return, check, feedline stop-check, blow-off, Univalve, instrument, gage, hydraulic, relief valves and strainers for service from 150 to 7500 lb with bolted, screwed, welded or pressure-sealed bonnet connections and with flanged, screwed or welding end connections. Write for catalogs.

Edward Valves, Inc.

Subsidiary of ROCKWELL MANUFACTURING COMPANY
1220 W. 144th STREET
EAST CHICAGO, INDIANA

Another Product

Service . . . where and when you want it

PROMPT, experienced service is one of the most important plus values you get when you buy Honeywell instruments. An unequalled organization of trained specialists is always at your call at more than 110 offices in the United States and Canada. Offices are located in practically every large industrial city of the country . . . close to every major production center.

Trained Personnel

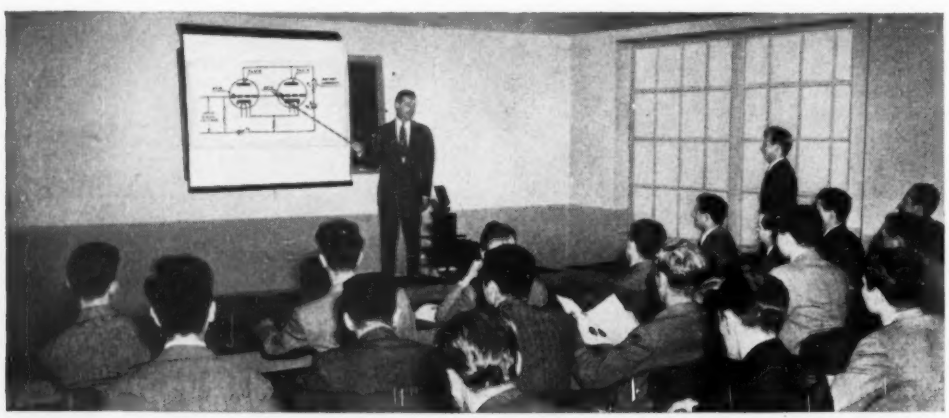
Honeywell service men are schooled not only in the theory of measurement and control, but also in the practical art of keeping good instruments in the best condition. Hand picked men begin this instrument education in an intensive training program in Honeywell factories. After graduation, they serve an apprenticeship in the field offices . . . while they learn still more about instrument maintenance from first-hand contact with plant problems. By the time a Honeywell man arrives at your plant on a call, he's a finished product worthy of the responsibility he bears, and capable of doing the kind of service job that you need . . . and that your Honeywell instruments deserve.

When trouble strikes, a wire or telephone call will bring a service man to your plant . . . often within a few hours. This assurance of prompt action means a lot to your production schedules. You'll never be left out on a limb because of delays in instrument maintenance.

Periodic Service Plan

But why wait for emergencies? Preventive medicine works on instruments, too. And the prescription is simple . . . a Periodic Service Contract, which brings a Honeywell service man to your plant at regular intervals to inspect, clean and adjust any Honeywell instruments you have. The plan is economical . . . can save you many hours of lost production time. Your nearest Honeywell office will be glad to give you full details.

A faster, stronger *for steam*



TRAINED TO SERVE: *In Honeywell's service school, students get a thorough grounding in instrument theory and practice. After graduation, they become part of the most extensive organization of its kind in the world . . . ready to serve you competently and promptly, whenever and wherever you need them.*

FOR getting high-speed, precise measurements of steam temperatures, the Brown butt-welded thermocouple is the ideal partner for *ElectroniK* instruments. This thermocouple's unique characteristics come from an entirely new kind of design, in which the two couple wires are electrically welded together in a butt joint.

The thermocouple is *faster*—because the mass of the junction is much smaller than the usual twisted joint. It's *stronger*—withstands vibration and shock better. And it's *more accurate*—because the loop formed at the joint prevents heat conduction from the junction back to the insulators.

A wide line of thermocouple wells is supplied for various steam plant applications . . . including a series especially designed for high pressure steam lines. All Brown thermocouple wells are precision-machined to highly uniform wall thickness, to guarantee dependability at high temperatures and pressures. They are available in a broad choice of standard sizes and designs, supplemented by special types made to individual specifications.

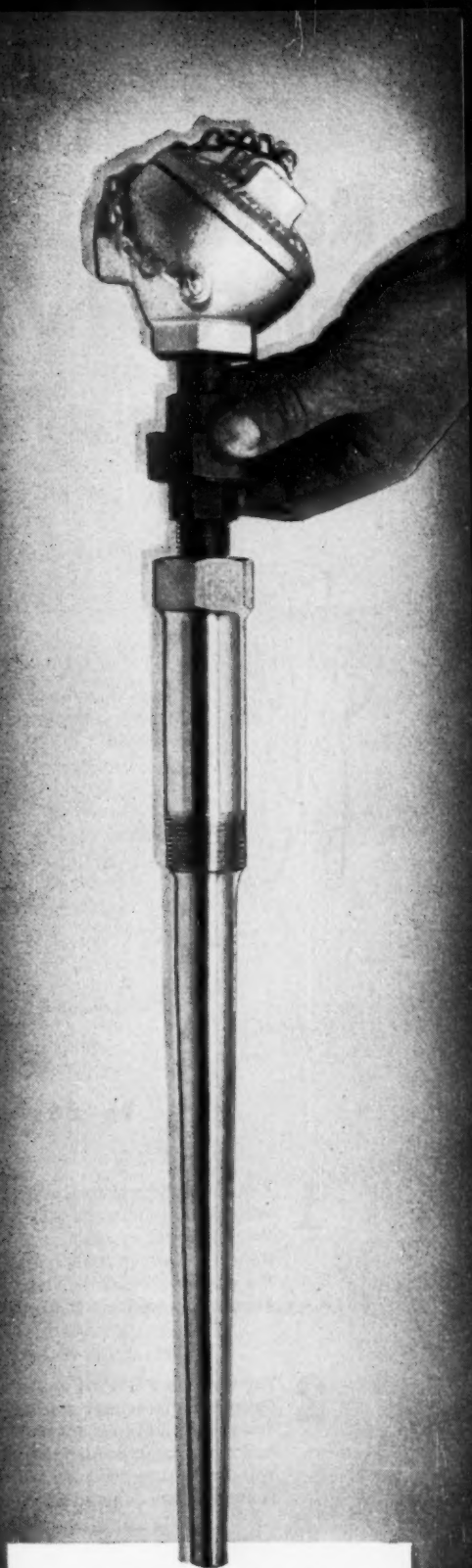
thermocouple *plant temperatures*

For specifying and purchasing all instrument supplies and accessories, you'll find new convenience and economy in the Honeywell Supplies Man—HSM—Plan. Your local HSM will be glad to explain the plan in detail, and to show you how planned buying can save you time and trouble. Call him today . . . he is as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, 4490 Wayne Ave., Philadelphia 44, Pa.

● **REFERENCE DATA: Write for Pyrometer Supplies Buyers' Guide No. 100-4 . . . and for Specification Sheet No. 200-2 on Thermocouple Wells.**

MINNEAPOLIS
Honeywell
BROWN INSTRUMENTS
First in Controls



STEAM THERMOCOUPLE *has tapered stainless steel well, precision-drilled to highly uniform wall thickness. Inset shows butt-welded thermocouple junction. The small mass gives fast response . . . curved wires prevent heat conduction away to the insulators.*

There's Reliable Power Here for Feedwater Pumps *Year after Year!*

Please examine this great E-M Motor
From bearings to coils to heavy-duty rotor.
Plant auxiliaries run hard and long
So driving motors must be extra-strong.
Read the rhymes and you'll see why
RELIABILITY makes *this* motor your best buy!
No tricky formulas you have to see—
Here we have it in 1-2-3!

Why E-M stresses its ability to design large motors for reliability

1 E-M coils hold moisture out
With high insulation strength all about.
With examination you'll be finding
Repeated varnish coats baked on the winding.
It's earned acceptance and admiration,
This E-M "power house" insulation!

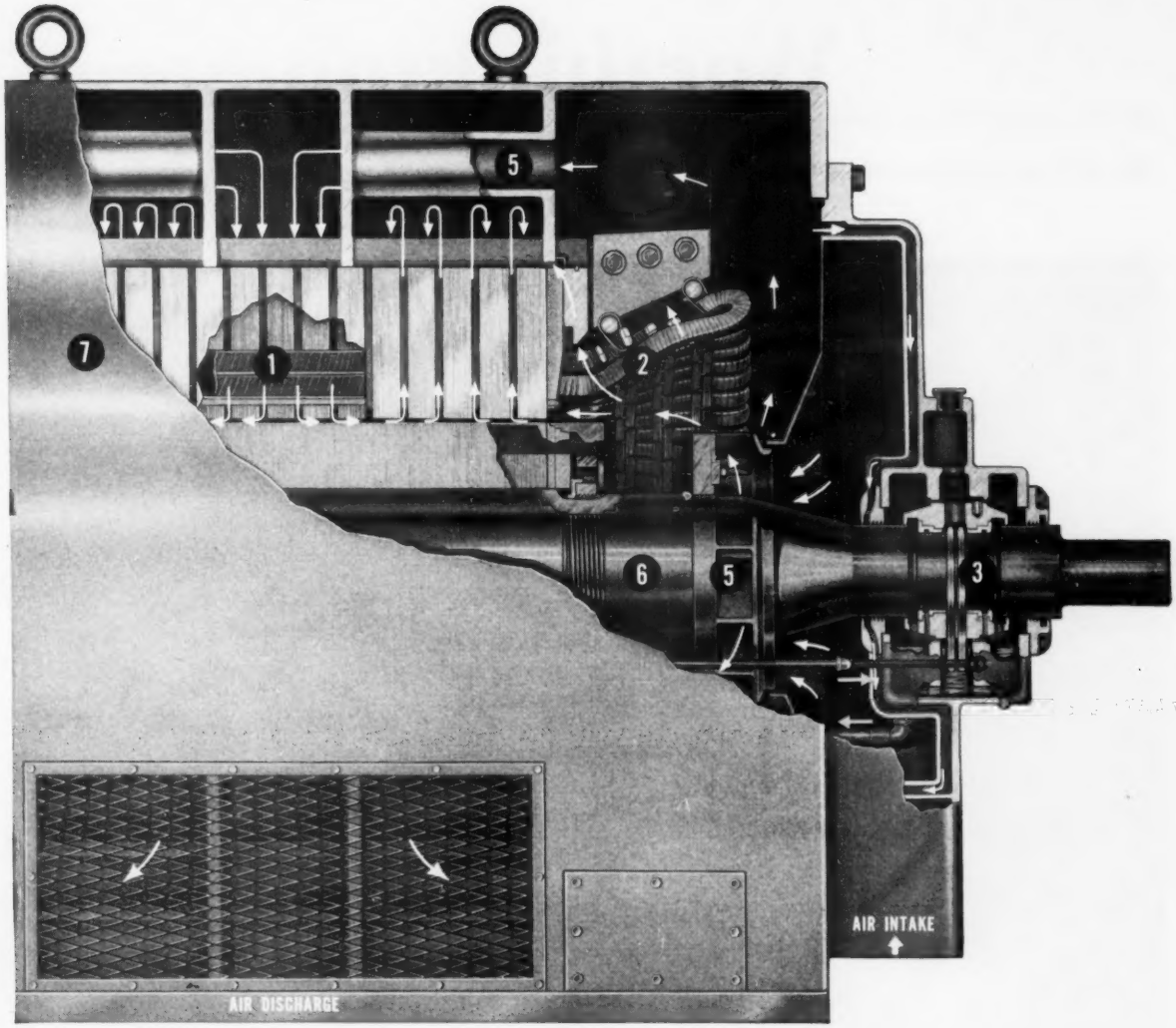
2 You won't find E-M coil-ends in any contortion
Caused by full-voltage starting distortion.
You see, all E-M coils are lashed to each other
And tied to big bracing rings one after another.
You can be sure this E-M coil-end bracing
Is equal to any demand it'll be facing.

3 E-M engineers have had plenty of school
In designing leak-proof bearings that always run cool.
Shaft journals are oscillation-honed so much clearer
Their super finish reflects your face like a mirror.
And the bearing sleeves are centrifugally cast
With strong bond and dense babbitt that last and last.

4 A great deal of your trouble-free operation
Will come from E-M's pressure lubrication.
Take special notice of this choice you are given—
Oil pump can be direct or separately driven.
The oil reservoir gets good ventilation
And it's easy to check the oil circulation.

5 The E-M air distribution is called "Center-flow"
It's uniformly controlled without "big blow".
Aero-dynamically designed blowers have plenty of poise,
Move air efficiently with minimum noise.
You're sure to see, wherever you start,
There's adequate air for each working part.

6 One thing you'll notice about this E-M Motor . . .
Extra-heavy construction of the strong, stiff rotor
Core laminations have interference fit,
For staying in place, this is really it.
The rotor is balanced with great precision—
A very important smooth-running provision.



E-M 2-Pole Heavy-Duty Squirrel-Cage Induction Motor (1500 HP and larger)

7 One of the most rugged things bearing the E-M name
Is the smoothly-contoured drip-proof frame.
And there's an added noise reduction
In this sleek modern enclosure construction.
It features a "turbine-driven generator" design
When you see it you'll say "This'll be mine!"

These have been some features which you can see—
Large E-M Motors show them tangibly.
Other E-M advantages are behind them, too,
Benefits just as important to you.

For instance, in the field of big motor design
E-M has specialized, straight down the line.
And a broad E-M service organization
Is on "split-second" call across the nation.

When you specify that big motor...now or next year,
Be sure to call an E-M sales engineer.
And before your plant plans get any bolder,
Write for the new big E-M 2-pole Motor folder!

E-M

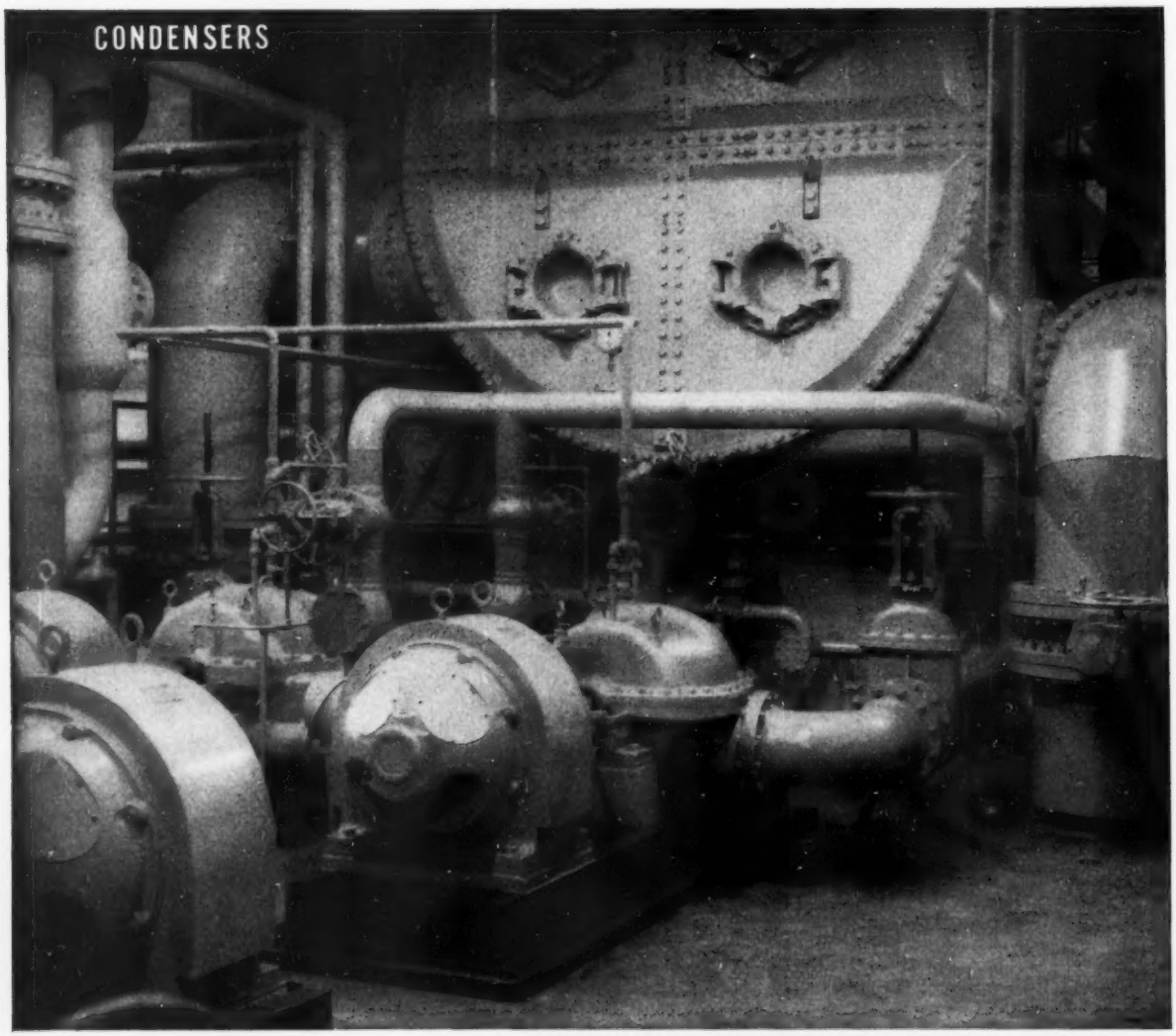
1300-TPA-2140

ELECTRIC MACHINERY MFG. COMPANY
Minneapolis 13, Minnesota

SPECIALISTS IN MAKING MOTORS DO EXACTLY WHAT YOU WANT THEM TO

Worthington Steam

News and information about Worthington equipment for the steam power plant



WORTHINGTON'S 37,500 SQUARE FOOT CONDENSER at Columbus and Southern Ohio's E. M. Poston Station

Shallow wells supply all water for this Worthington-equipped power plant

The E. M. Poston Generating Station of the Columbus and Southern Ohio Electric Company, presently rated at 200,000 kw, gets its entire water supply from shallow wells 7000 feet away from the plant site. A 40-million gallon reservoir stores well water for emergency use.

Worthington equipment at the Poston Station now includes 3 condensers with all auxiliaries, including steam-jet ejectors, circulating water and condensate pumps—also deaerators, evaporator preheaters, and miscellaneous equipment.

Worthington, with over a century's experience in the manufacture of steam power equipment, is equipped to build efficient condensers in sizes to suit any practical limitations. Recently, the largest single-shell condenser in the world—125,000 sq. ft.—was made by Worthington for a large utility.

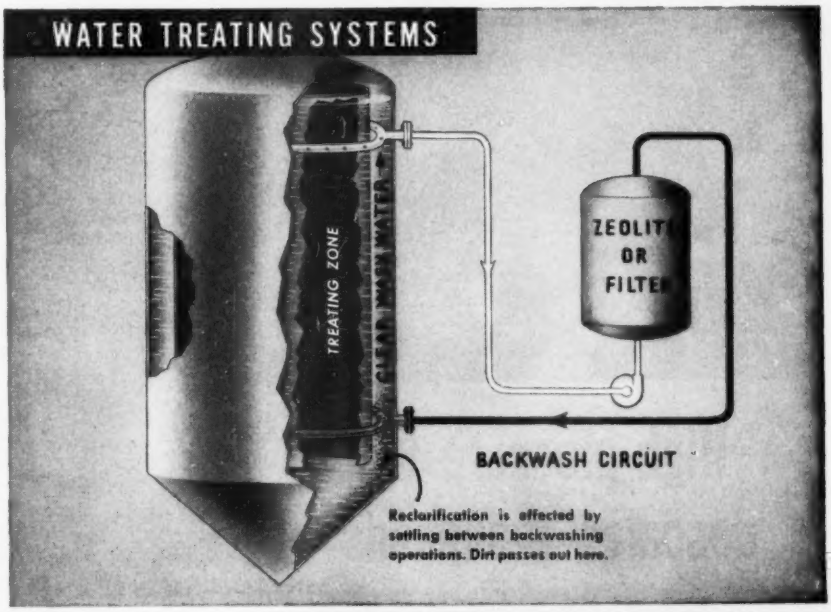
Power Bulletin

Condensers, deaerators, water-treating systems, and steam-jet ejectors and vacuum pumps as well as turbine generators, mechanical drive turbines and gears, circulating, condensate and boiler feed pumps, pressure filters, and air compressors.

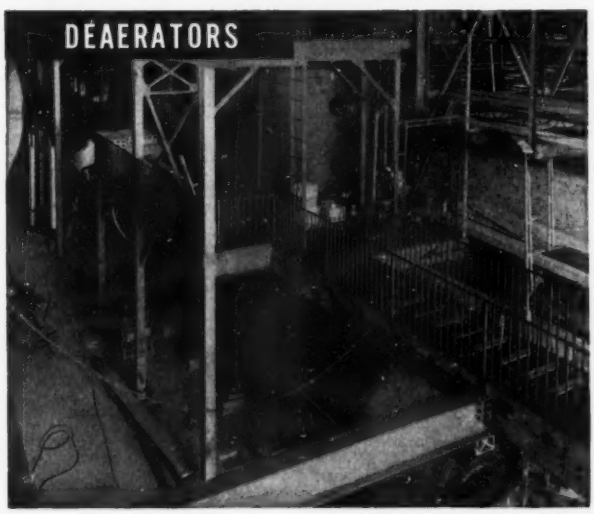
You can't wash clean with dirty water!

Every Worthington standard Hot-Z or conventional system provides exclusive, *independent* facilities for backwashing zeolite or filters with clean, hot, chemically inert water, without disturbing the normal flow through the reaction tank.

This unique backwashing provision is just one of many Worthington exclusive features, but it alone more than justifies the selection of a Worthington system for hot-processing boiler feedwater in your plant.


WATER TREATING SYSTEMS
TREATING ZONE
ZEOLITE OR FILTER
BACKWASH CIRCUIT
Reclarification is effected by settling between backwashing operations. Dirt passes out here.

BACKWASH FLOW CIRCUIT IN WORTHINGTON HOT-PROCESS SYSTEM shows how *independent* built-in annular wash-water compartment* provides clean, hot, chemically inert water for backwashing.
*Reg. U.S. Pat. Off. 2,263,398



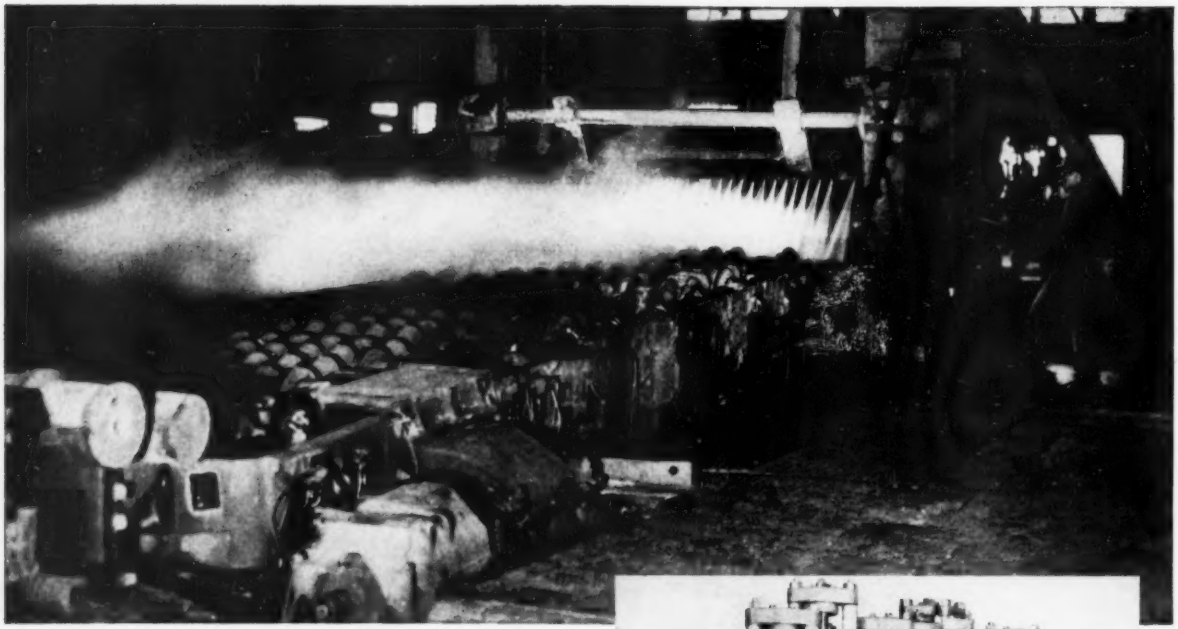
Dayton installs its newest Worthington deaerator

Worthington has supplied the deaerators for each new Dayton Power and Light Company installation since 1936. This new deaerator being installed at the O. H. Hutchings Station, in southwestern Ohio, is one of many Worthington units built in sizes to handle from a few thousand pounds per hour to over a million. Both tray and steam-jet types are made, with external surface-type vent condensers or internal direct-contact vent condensing. With a complete range of sizes and types at their fingertips, Worthington engineers can give you a deaerator exactly suited to your needs.

S.3.1B

Get in touch with your nearest Worthington district office for bulletins and information. Or write to Worthington Corporation, Steam Power Division, Section S.3.1, Harrison, N. J.

WORTHINGTON



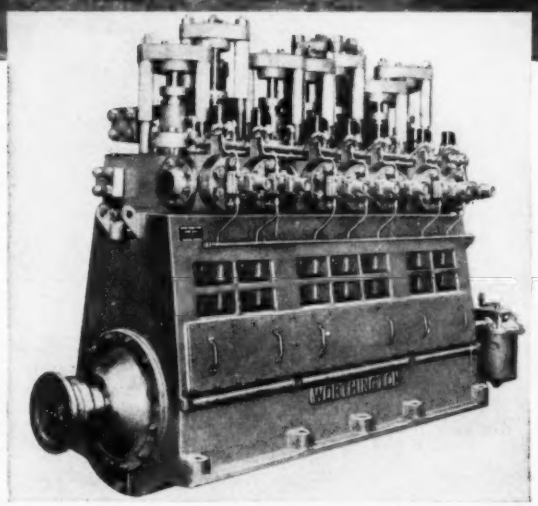
High-pressure water descales thousands of tons of steel daily

It takes vast quantities of high-pressure water to remove the scale from steel sheets, plates and billets going through rolling mills like the one shown above.

To deliver high-pressure water for this kind of work, more and more leading names in industry are specifying Worthington heavy-duty multi-plunger power pumps. Here are some of the reasons why:

Worthington's patented synchronized suction-valve unloading allows delivery to start or stop as often as you want, quickly but gradually, without any shock or disturbance.

Ceramic plungers, optional on all of Worthington's power pumps, are precision-made for complete and easy interchangeability. As hard as tungsten carbide, these plungers resist corrosion, abrasion and breakage.



WORTHINGTON HEAVY-DUTY MULTI-PLUNGER POWER PUMPS deliver high-pressure water for use in hydraulic descaling system in this rolling mill. These rugged pumps are also used in hydraulic press work, foundry cleaning systems, hydrostatic testing and high-pressure process pumping.

Individual valve-hole covers permit quick and easy access for valve maintenance without disturbing piping.

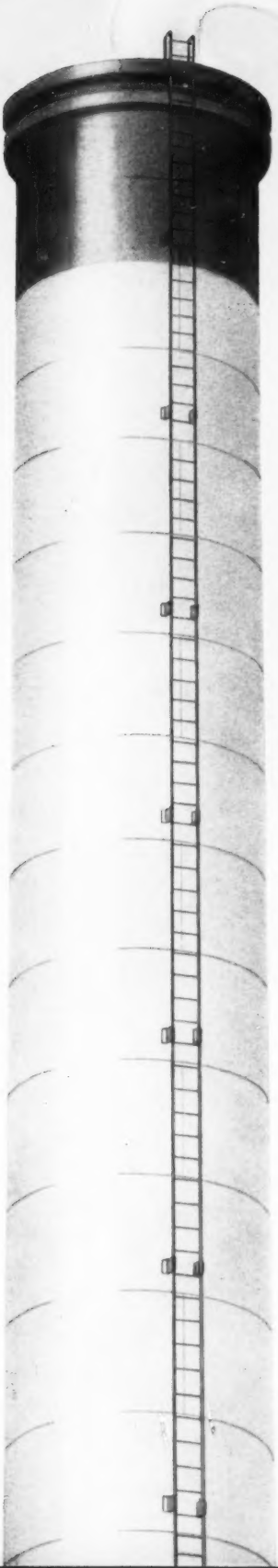
Get all the facts about these dependable, long-lived pumps. Write for the free Power Pump Bulletin, W-415-B1, to Worthington Corporation, Reciprocating Pump Division, Harrison, N. J.

P.3.6

The World's Broadest Line Assures You the Right Pump for Every Job

WORTHINGTON

Power Pumps



Please turn this page to see how this stack looked before the installation of an American Blower ST Fly Ash Precipitator.

Serving home and industry

AMERICAN-STANDARD • AMERICAN BLOWER • CHURCH SEATS & WALL TILE • DETROIT CONTROLS • KEWANEE BOILERS • ROSS HEATER

If your stack belches fly ash like this...

why not install an American Blower Type ST Fly Ash Precipitator now?

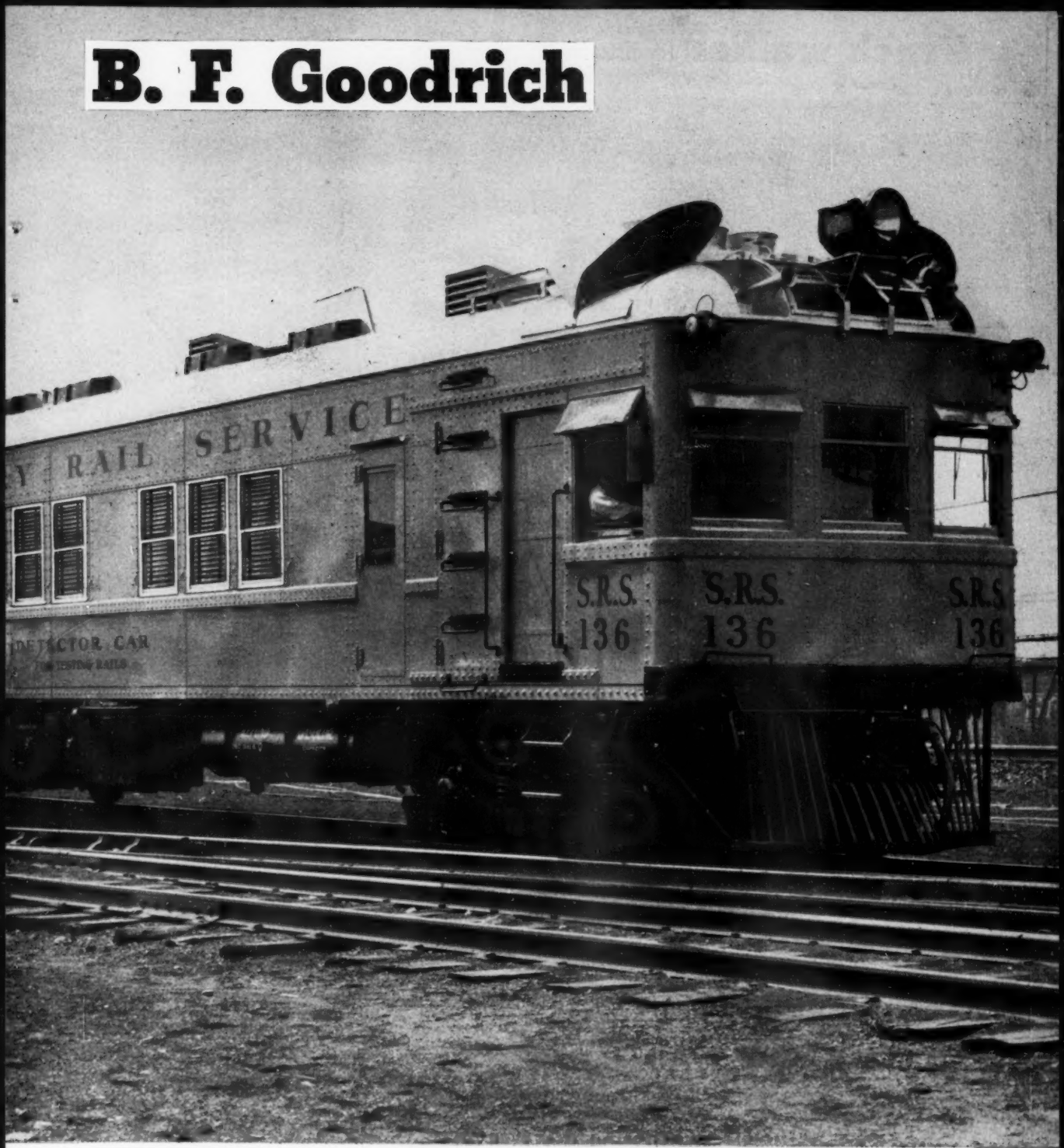
AMERICAN BLOWER

AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO
Division of American Radiator & Standard Sanitary Corporation

Serving home and industry

AMERICAN-STANDARD • AMERICAN BLOWER • CHURCH SEATS & WALL TILE • DETROIT CONTROLS • KEWANEE BOILERS • ROSS HEATER

B. F. Goodrich



Mechanical railroad "detective" with X-ray eyes that can "see" right through steel helps prevent train accidents.

"Track walker" sees through steel

That car inspects more railroad track in a day than a man on foot could cover in a week. Delicate electrical equipment detects hidden flaws a man could never see. Two big generators supply the electricity, but the belts needed to run them caused trouble. Ordinary V belts stretched badly; replacement was frequent and costly. On the next page you'll see how an entirely different kind of belt solved the problem.

Track walker (continued)

Belts that slipped and stretched set off a chain reaction that spoiled the vision of X-ray eyes in the Sperry Detector Car.

THE problem described on the preceding page was solved when B. F. Goodrich Grommet V belts were installed. Grommet belts are more flexible, don't slip or stretch as much as ordinary belts. Now BFG Grommet belts are giving 3 times the service of other belts, saving belt costs, and cutting repair and maintenance time by 60 per cent. Here's the reason Grommet belts last longer, serve better, save money.

Strongest V belt made

All the load-carrying cords in Grommet belts are concentrated in twin grommets. These grommets are cord loops made like giant twisted cables except that

they're endless. Since there are no center cords, the Grommet belt is more flexible, and so can "give" temporarily and absorb shock loads. As a result, Grommet belts last 20 to 50% longer, depending on the service. (The more severe the service, the greater the increase over ordinary belts.)

No weak spots

The section where cords overlap is the weak spot in ordinary belts. That's where 80% of V belt failures occur. But in Grommet V belts this cause of belt failure has been eliminated. The grommets are endless. There are no splices or overlaps—no weak spots to cause premature belt failure.

1/3 more gripping power

Grommet V belts have more rubber in relation to belt size. Without any stiff overlap, they're more flexible, grip sheaves better. Size for size, Grommet belts give ⅓ more gripping power with less slip, pull heavier loads with a higher safety factor. And because there is less slip, there is also less surface wear.

Less stretch

In ordinary belts under tension, the center cords loaf, the outer cords overwork because tension is greater near the driving faces. Grommet belts, with no center cords, have much more strength and less stretch. Grommet belts stretch, on an average, only about ⅓ as much as ordinary belts.

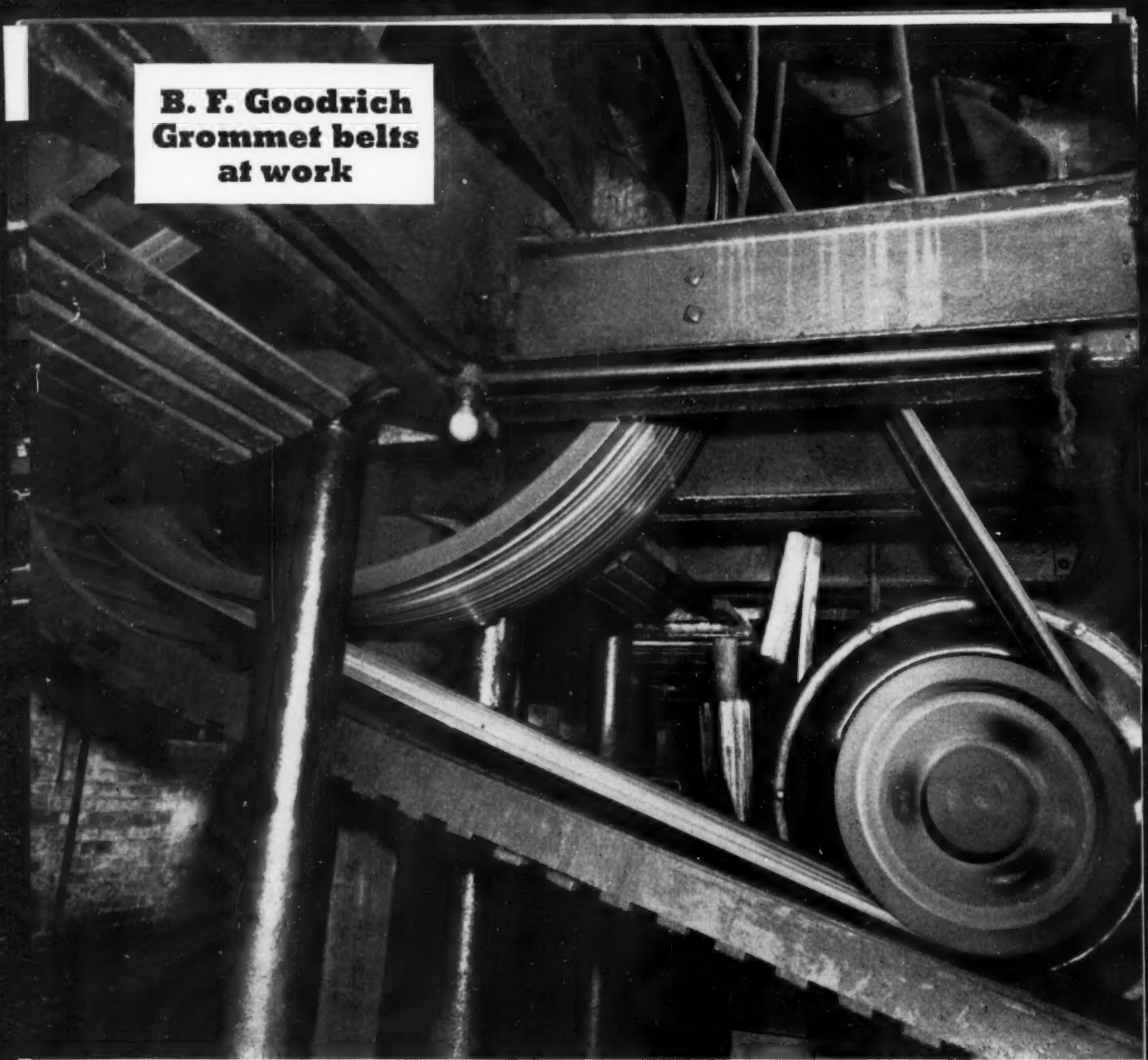
Save 3 ways

With Grommet belts, you save on replacement costs because they last 20 to 50% longer, on production costs because machines keep running with fewer interruptions, and on maintenance costs because V belts need less attention. Yet these savings they can make for you are all clear profit because they cost not one cent more than ordinary V belts. Only B. F. Goodrich makes the patented Grommet belt.

Highway robber

When this drive stops, rock needed for highway construction doesn't get crushed, new roads don't get built on schedule. Belts previously used to drive the rock crusher suffered from shock loads, wore out fast. Then a B. F. Goodrich man suggested Grommet V belts to stand the jerks and hard pulls. Grommet V belts shown here have been in service 2 years, production has been increased 25%, maintenance time has been reduced.

Jolting, crunching action of rock crusher used to cause production "hold-ups".



Whirl beater

Three pulp beaters in this paper plant are driven by one set of V belts. The old-fashioned belts, previously used, took twice as much space, slipped and stretched, required frequent maintenance, and had to be replaced every year or so. A B. F. Goodrich distributor heard about the trouble, and recommended a switch to the new, improved Grommet V belt. It proved to be a perfect solution. Installed in 1946, the BFG Grommet belts you see in the picture have already outlasted former belts 4 to 1, slippage has been reduced to a minimum, and there's no more downtime for belt repairs.

Grommet=T. M. The B.F. Goodrich Co.

The B. F. Goodrich Company
Dept. M-99, Akron 18, Ohio

☐ Send set of reports telling users' experiences and showing actual installations where Grommet belts outlasted all others.

☐ Please have a BFG distributor call. I'd like to find how I can save money with Grommet V belts.

Name_____

Firm Name_____

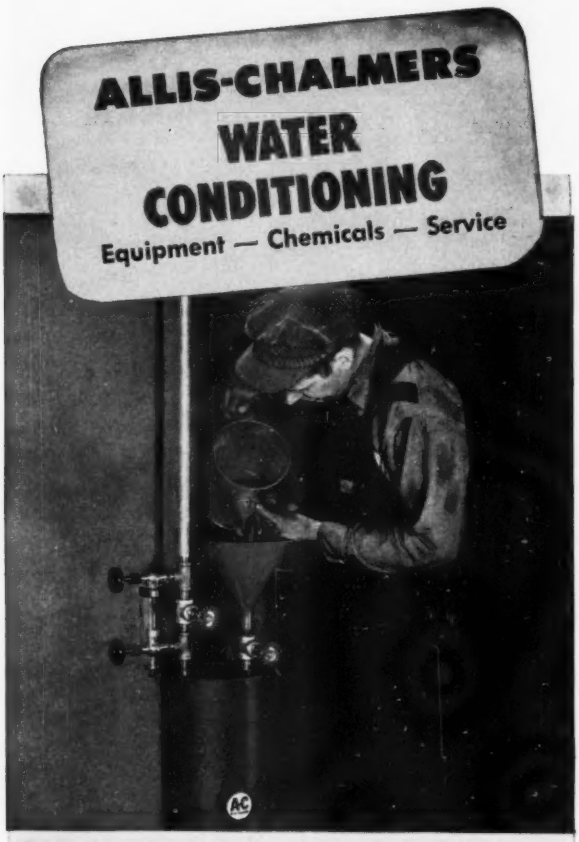
Address_____

_____

B.F.Goodrich
INDUSTRIAL PRODUCTS DIVISION

How to Solve Boiler Problems caused by

HIGH CIRCULATING RATES



Recent trends toward high circulating and high heat transfer rates mean that careful attention to water side protection of boiler surfaces will pay off in lower fuel costs and easier maintenance. Information that will help you analyze this problem and work out an effective solution is contained in Allis-Chalmers water conditioning Bulletin 43. It explains the problem. It tells what solution is available. And it tells how to apply this solution.

Based on Allis-Chalmers Experience

Bulletin 43 is one of a series of Allis-Chalmers bulletins on water conditioning problems. Each of these bulletins contains information that will help you solve some of your problems. They are based on Allis-Chalmers wide experience handling water problems for nearly every industry. In addition, they are based on Allis-Chalmers long experience building steam turbines and power plant equipment.

Complete Service Available

Allis-Chalmers gives you complete water conditioning service. You can get analyses and reports on your problems. You can get the chemicals needed in all water treatments. And you can get the equipment needed in any system.

A-4035

Equipment for all water treatments is available from Allis-Chalmers. Picture shows feeder installation similar to equipment used in water side protection of boiler surfaces.

For your copy of Bulletin 43 on internal treatment for water side protection of boiler surfaces, write Allis-Chalmers, Milwaukee 1, Wisconsin. Or better, call your nearby Allis-Chalmers district office and have an Allis-Chalmers representative consult with you on your water problems.

ALLIS-CHALMERS

OPERATOR CHECKS READINGS OF HAYS ELECTRONIC OXYGEN METER WHEN BURNING MULTIPLE FUELS

THESE INNOVATIONS IN BOILER PLANT INSTRUMENTATION ARE MAKING NEWS

New instruments meet demands of outdoor boilers, space saving, greater speed of response, multiple fuel firing

Boiler plant instrumentation is changing.

Electrically operated combustion control is being used more and more as larger numbers of outdoor boilers are installed. For all-weather operation electric combustion control is preferred since electricity doesn't freeze, is readily available, doesn't require expensive compressors and dryers, allows maximum freedom in the location of the control room.

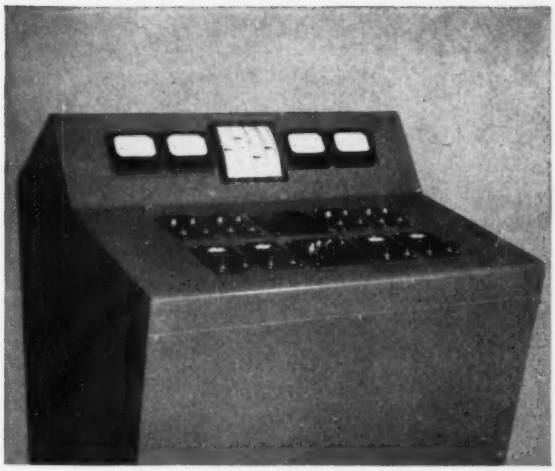
More miniature indicators and control stations mounted on console or graphic panels are appearing as operators demand more instruments in less space. All essential information is concentrated for fingertip control while supplementary indications and recordings are located on adjacent standard size panels.

Electronic instruments are becoming more numerous because they give faster speed of response and greater accuracy, can be placed anywhere, eliminate pressure lines into the panel.

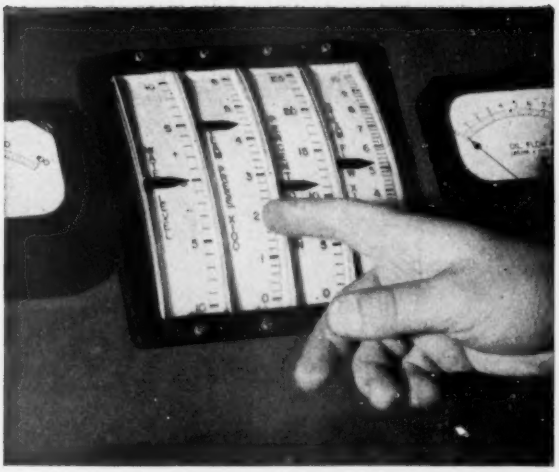
Oxygen recorders have become standard equipment where fuel flexibility is desired. Unlike other combustion guides, oxygen measurement is unaffected by the varying Hydrogen-Carbon ratios of different fuels, hence gives the *only* accurate check where more than one fuel is being burned.

In response to these trends The Hays Corporation offers the complete, modern boiler plant instrumentation line including electric combustion control; highly visible, internally illuminated Miniscales; custom-made panels; new electronic mercury-less flow meters; new 1, 2 and 3 element electronic feedwater control; combustion guide instruments of every type including the Magno-Therm electronic oxygen recorder.

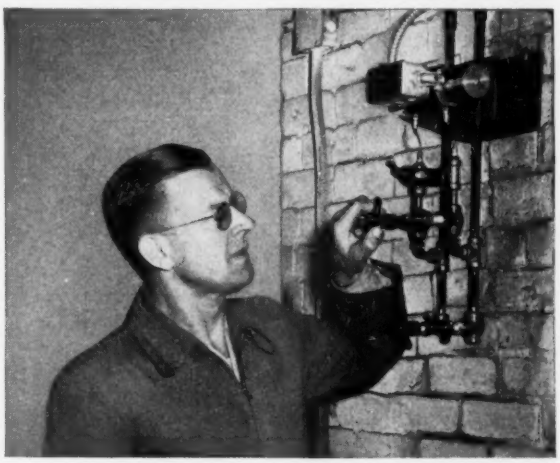
Write for free bulletins on any of these products—available from The Hays Corporation, Michigan City, Ind.



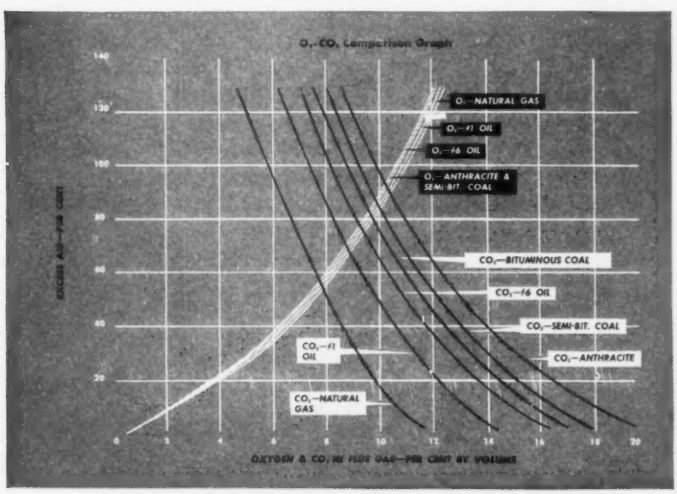
MORE INSTRUMENTS IN LESS SPACE has been accomplished with Hays Miniscales on a console panel. Miniscales indicate any variable. Transmission is either electrical or pneumatic on highly visible, internally illuminated 5″ scales. Hays console panels are custom-made to conform to individual specifications.



OUTDOOR BOILERS, which eliminate the need for expensive enclosures, demand all-weather dependability from controls. Hays all-electric combustion control doesn't freeze, eliminates expensive dryers and compressors.



ELECTRONIC INSTRUMENTS have greater speed of response and accuracy. Here operator inspects transmitter of new Hays electronic mercury-less flow meter. Recorder can be located at remote distances from transmitter.

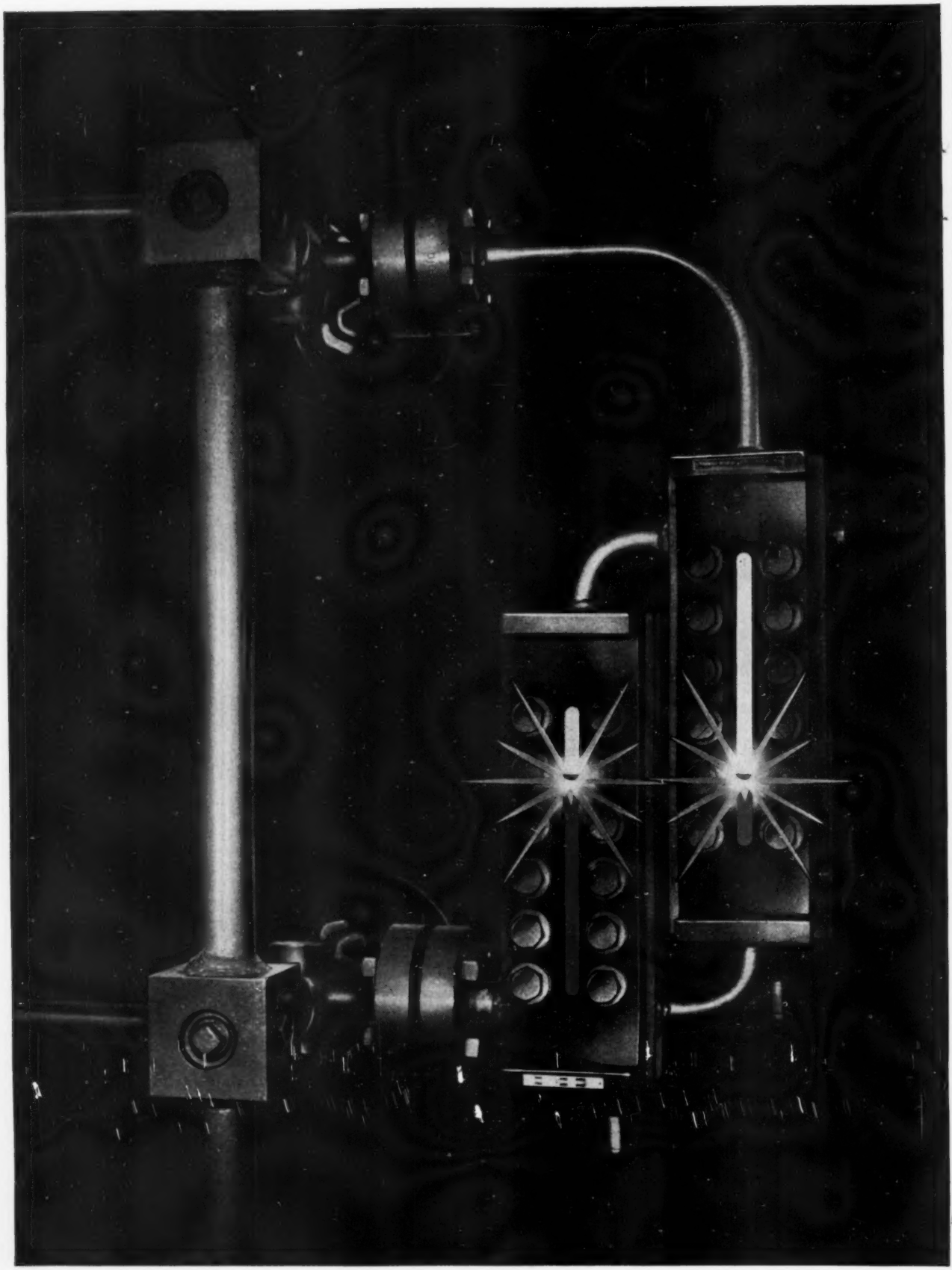


IN BURNING MULTIPLE FUELS only 0_2 gives an undistorted picture of excess air present in flue gas — as demonstrated by this graph.

Automatic Combustion Control
Boiler Panels • Hays-Penn Flowmeters
Veriflow Meters and Veritrol
Gas Analyzers • Draft Gages
Combustion Test Sets • CO_2 Recorders
Electronic Oxygen Recorders
Electronic Flowmeters
Electronic Feed Water Controls
Miniature Remote Indicators

THE hays CORPORATION

MICHIGAN CITY, 3, INDIANA



VISIBILITY THAT SHINES LIKE A STAR

IT'S LIGHT! IT'S BRIGHT! IT'S RIGHT!

You see instantly the accurate boiler water level in your Yarway Flat Glass Gage because *the meniscus at water level stands out like a brilliant star* . . . thanks to the Yarway Type "M" Illuminator.

The Type "M" Illuminator is specially-designed to give maximum brilliance to Yarway flat glass inserts, and to spot the water level over its entire traverse. The superior penetration of its light cuts through extraneous light, dust particles in the air, and deposits on the gage glasses. Because of its brilliance it is effective over longer distances.

LONG LIFE FOR GAGE GLASSES

The new Yarway flat glass water gage assembly was developed to meet demands for greater dependability, longer life and more accurate readings. Many hundreds of installations in high pressure plants all over the country are proving that it does all this.

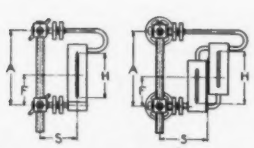
Gage glass inserts are of the Yarway pressure-sealed "floating assembly" type that distributes pressure evenly, minimizing leakage and glass breakage . . . greatly extending gage glass life.

For wide ranges, greater flexibility is gained by using two independent inserts, and by interconnecting expansion loops. Other new features (1) Yarway Welbond gage valves, (2) short connection to drum assuring greater accuracy and eliminating a stuffing box on the lower connection, (3) upper flanged loop connection between insert and gage valve allows expansion and contraction of the various components, (4) tie-bar-type water column linking gage valve provides circulation to keep gage nearer drum temperature.

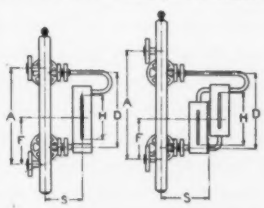
FOR EVERY HIGH PRESSURE BOILER

There is a Yarway Water Column and Gage combination for every boiler 600 psi and over. For full descriptions write for Yarway Bulletin WG-1811.

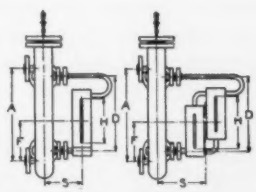
YARNALL-WARING COMPANY, 100 Mermaid Ave., Philadelphia 18, Pa.



Yarway Tie-Bar-Type Water Column with single or double inserts.

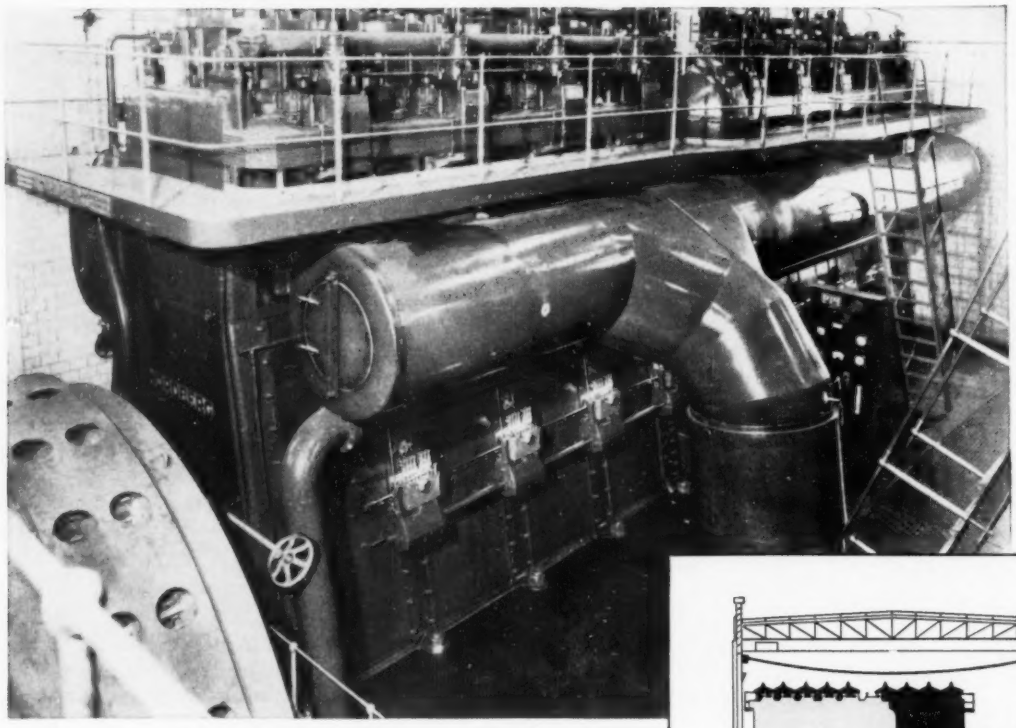


Yarway No-Alarm Water Column with single or double inserts.

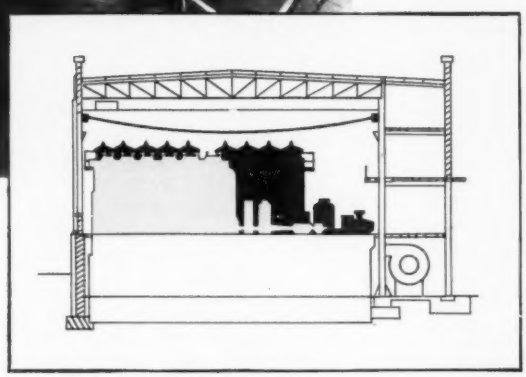


Yarway 5" Hi-Lo Alarm Water Column with single or double inserts.

YARWAY® / water columns and gages



Shown here is the fourth large, heavy duty oil burning Nordberg 2-cycle Diesel to be installed in the Grand Haven plant . . . a 7000 hp, 5000 kw unit.



Outstanding economy and reliability of NORDBERG two-cycle DIESELS proved in 15 years of Municipal Power Expansion

Experience of the City of Grand Haven, Michigan, is evidence of the ability of Nordberg Diesel Engines to meet ever-increasing power requirements.

Starting over fifty years ago with a modest steam engine plant, Grand Haven has progressed through turbines, smaller internal combustion engines, and, in the last 15 year period, to the use of large Nordberg 2-cycle Diesels, ranging from 2250 to 7000 hp, as their main power supply. Their recent selection of a fifth Nordberg unit provides further proof of the outstanding reliability of these low speed, heavy duty engines.

It is important to note that the established economy of Nordberg Diesels is further enhanced in the Grand Haven plant through their ability to operate efficiently and economically on heavy, straight-run residual fuel oils. Operating records, covering over a year's operation show, for example, that the 7000 hp Nordberg Diesel has been producing power for an impressive 14.16 kwh / gal. of fuel.

This is another good example of the varied power problems being solved better, more economically with Nordberg Diesels.

MODERN DIESEL POWER GREATLY INCREASES PLANT CAPACITY

Not only has modern Diesel power brought excellent fuel economy to Grand Haven, but it has also given the plant six times as much power installed in a given building section.

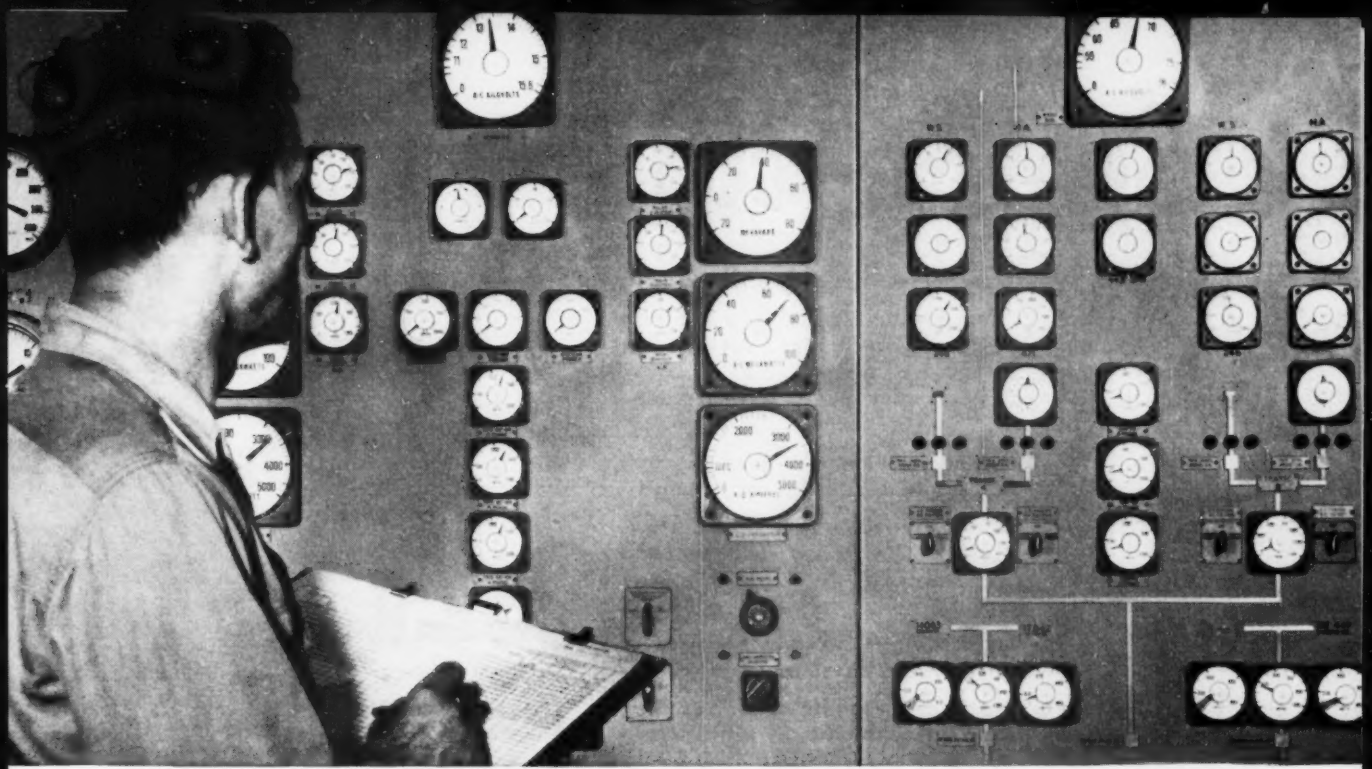
The expansion that provided room for the last Nordberg engine, a 7000 hp unit, is almost identical in area to that occupied by any one of the three original 1140 hp Diesel engines.

NORDBERG MFG. CO.
Milwaukee, Wisconsin

NORDBERG

DIESEL • DUAFUEL® AND SPARK-FIRED GAS ENGINES

P953



G-E SHADOW-PROOF INSTRUMENTS OFFER SMALL SIZE FOR ECONOMY OF SPACE AND A LONG SCALE FOR EASY READING.

Modernize with G-E Small-size Instruments And Save up to 33% of Switchboard Space

General Electric switchboard instruments can help you to economize in your plans for plant modernization or expansion by allowing more efficient use of switchboard space.

SPACE-SAVING DESIGN of G-E switchboard instruments makes it possible for you to save as much as 33⅓% of valuable switchboard space. A long-scale face only 4¼ inches across is attained because the instrument is designed to operate throughout a 250° arc.

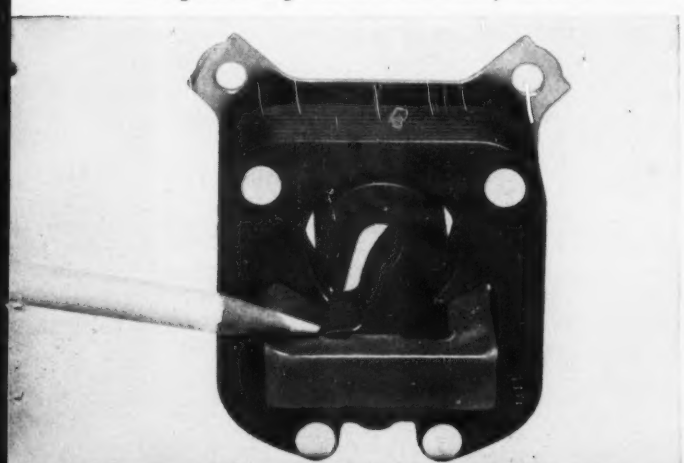
SUSTAINED ACCURACY—±1% of full scale—is assured by building these long-scale instruments around a one-piece magnetic circuit. Since the circuit is thus made a solid mass, the air gap can never vary. Flux always flows evenly to give you accurate readings time after time.

FOR MORE INFORMATION, contact your G-E Apparatus Sales representative, or write for bulletin GEC-218 to Section 602-268, General Electric, Schenectady 5, N. Y.

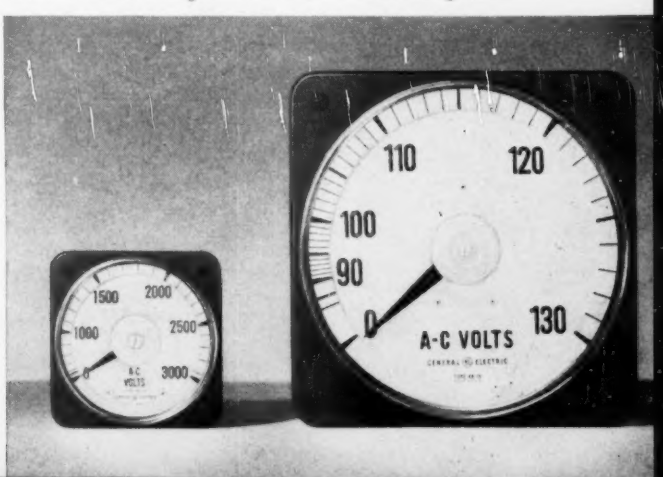
You can put your confidence in—

GENERAL ELECTRIC

ONE-PIECE CONSTRUCTION of the G-E magnetic circuit provides a permanent air gap. Flux density, therefore, always remains uniform—making for readings which are consistently accurate.



TWO SIZES AVAILABLE—including both 4¼-inch and 8¾-inch instruments. The large size instrument is designed for those applications where readings must be taken at extra long distances.



Space-saving rugged

Built, shipped and installed as a compact unit, the new Elliott geared turbine has many advanced features that fit it to the most exacting requirements. Here are some of them:

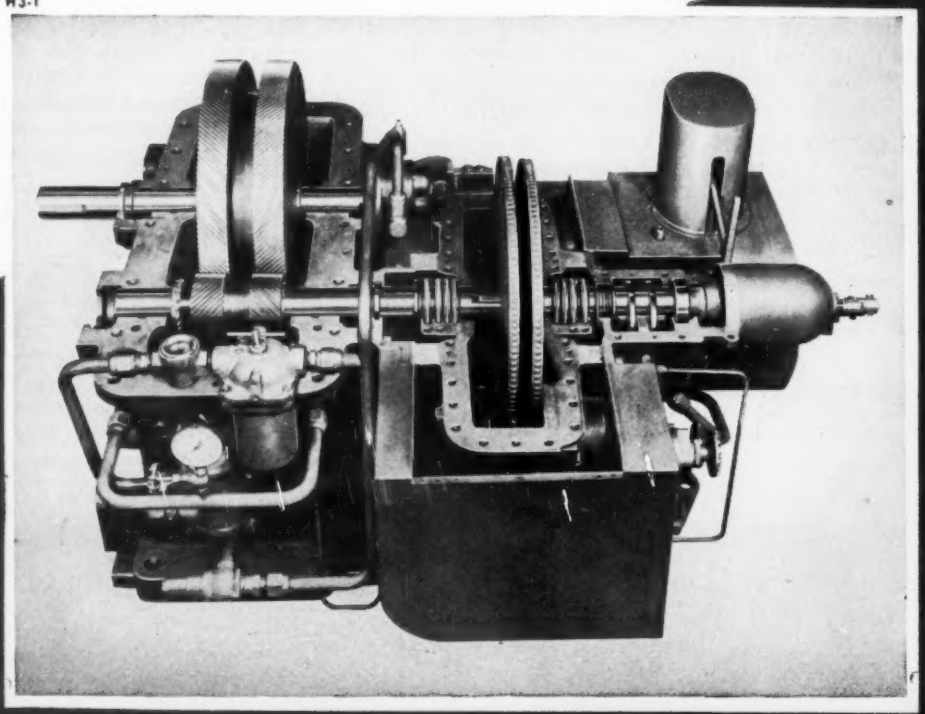
- **Turbine wheels and pinions mounted on a single sturdy high-speed shaft—**
- **Double-helical gears and pinions eliminate end thrust and the need for maintaining critical thrust bearing.**
- **Requires no base plate or external oil reservoir. Three-point support.**
- **Neatly arranged lubrication system, with all external oil piping connected to lower casing.**
- **Liner-type bearings . . . gear-type oil pump, self-priming . . . Kingsbury floating-ring type oil seals with slingers.**

Also built in coupled design, with pinion shaft flexibly coupled to the turbine.

only one of many vital factors in the new

ELLIOTT Geared Turbine

H3-1



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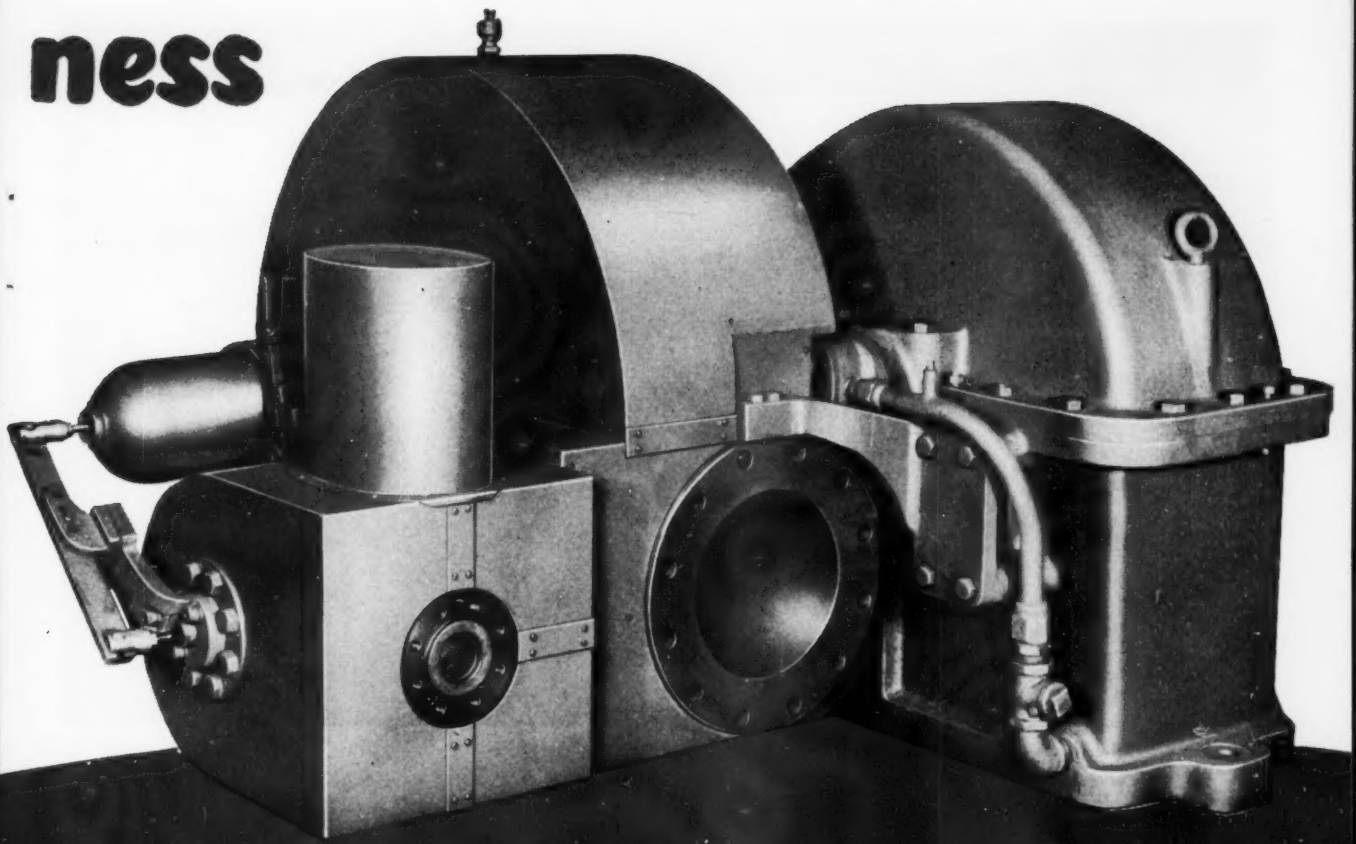


THE TURBINE

The new "built-in" Elliott geared turbine employs the sturdy and dependable YR turbine. This proved turbine design is adaptable to practically all operating requirements and is economical in both operation and maintenance.

Outstanding features are centerline support, stainless steel turbine buckets and shroud, dynamically balanced rotors, and the choice of several governors to be used with the standard overspeed governor. The wide use of standardized parts that fit all sizes of YR turbines simplifies maintenance and the stocking of parts.

THE GEARS

Gear and pinion are double-helical (herringbone) type, precision-hobbed, quiet, and long wearing. Tooth spacing is held to extremely close tolerances. Conservative proportioning of the teeth minimizes pinion deflection and permits a uniform, low tooth load.

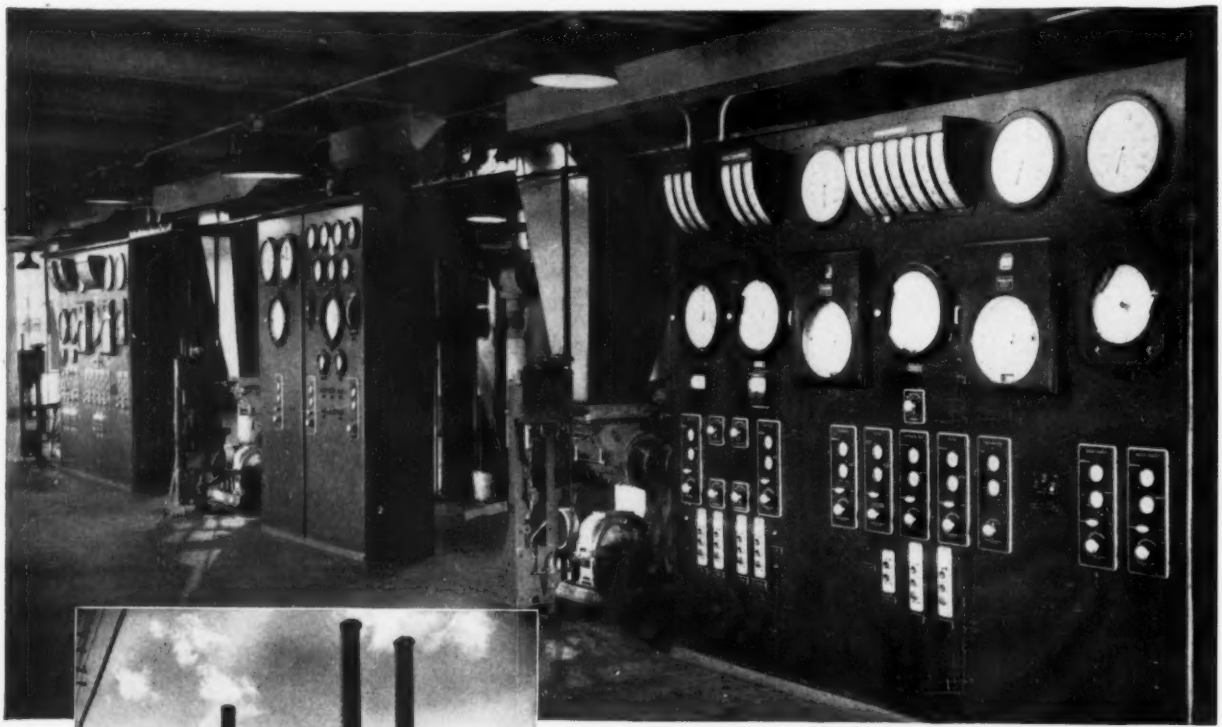
Both the high- and low-speed gear shafts are provided with an oil slinger combined with a special seal. This design prevents leakage of oil from the gear case and eliminates the introduction of water, steam, or impurities into the gear case.

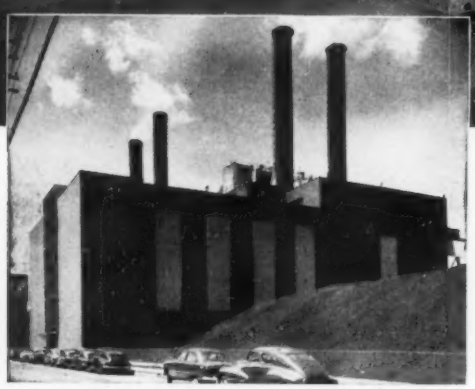
All Elliott gears, built-in or coupled, include a self-contained, forced-feed lubrication system which circulates oil at high pressure to both gear and turbine bearings. In addition, two spray nozzles in the gear casing direct a sheet of oil concentrically into the meshing point of the gear and pinion teeth, cooling the teeth and lubricating the contact area.

Full details on the new Elliott Geared Turbine are given in Bulletin 11-19, just released. Bulletin 11-16 describes the YR turbine line. Contact your local Elliott district office or write Elliott Company, Jeannette, Pennsylvania.

ELLIOTT Company

STEAM TURBINE DEPT.





The Jamestown plant is efficient and modern, inside and out.

Control and

AT JAMESTOWN, NEW YORK MUNICIPAL LIGHT PLANT

REPUBLIC Automatic Combustion Controls Operate Boilers at Test Efficiency to:

SAVE FUEL **by maintaining maximum combustion efficiency continuously.**

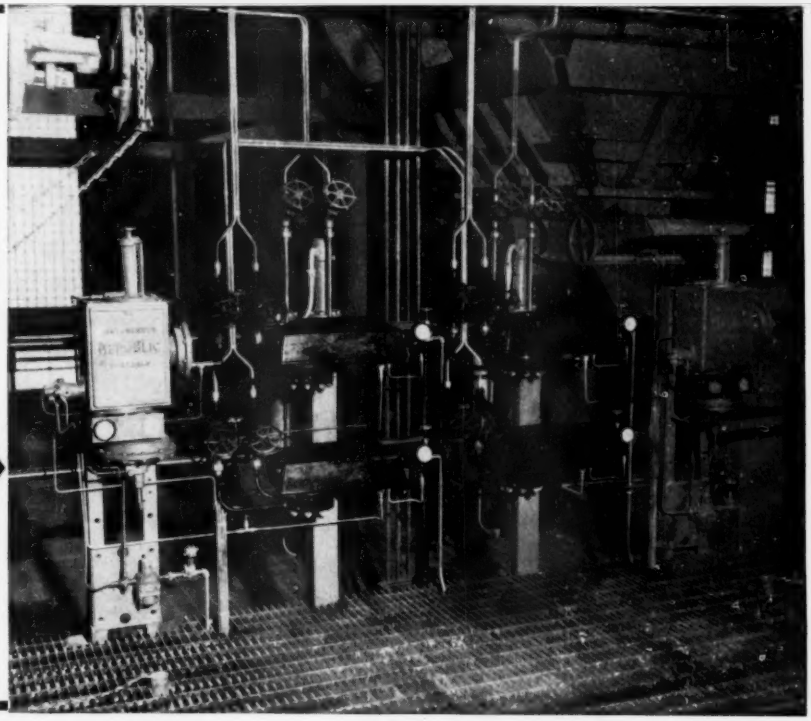
SAVE MAINTENANCE AND EQUIPMENT **by holding uniform operating conditions. Chain-of-event type of trouble that frequently develops as a result of incorrect boiler operation is prevented.**

SAVE MANPOWER **by automatically performing many repetitive adjustments.**

HIGHLY IMPORTANT **during this critical power shortage, the Jamestown plant meets peak load demands because, with REPUBLIC Combustion Controls, it gets all of the steam output the plant boilers are rated for.**

These panels are part of the REPUBLIC Automatic Control System that is used exclusively in the Jamestown plant. When desired, manual operation of the entire boiler system can be made from this location. Panel in the center houses master gauges and other coordinating equipment while panels on either side contain gauges, meters and controls for boilers. REPUBLIC Positioners at left of each panel vary rate of coal feed to pulverizers.

REPUBLIC Regulators and Flow Transmitters are used in the two-element feedwater control system. Rate of feedwater flow to the boiler is changed immediately with a change of either steam flow or feedwater drum level.



Savings are Automatic

At the Jamestown, New York, Municipal Light Plant, two 150,000 lb. per hr. boilers rated at 900 psig. and 900° F.T.T. supply steam to a 20,000 kw turbine. Steam at 275 psig. and 600° F.T.T. is also supplied through a pressure reducing and desuperheater station to an adjoining older plant.

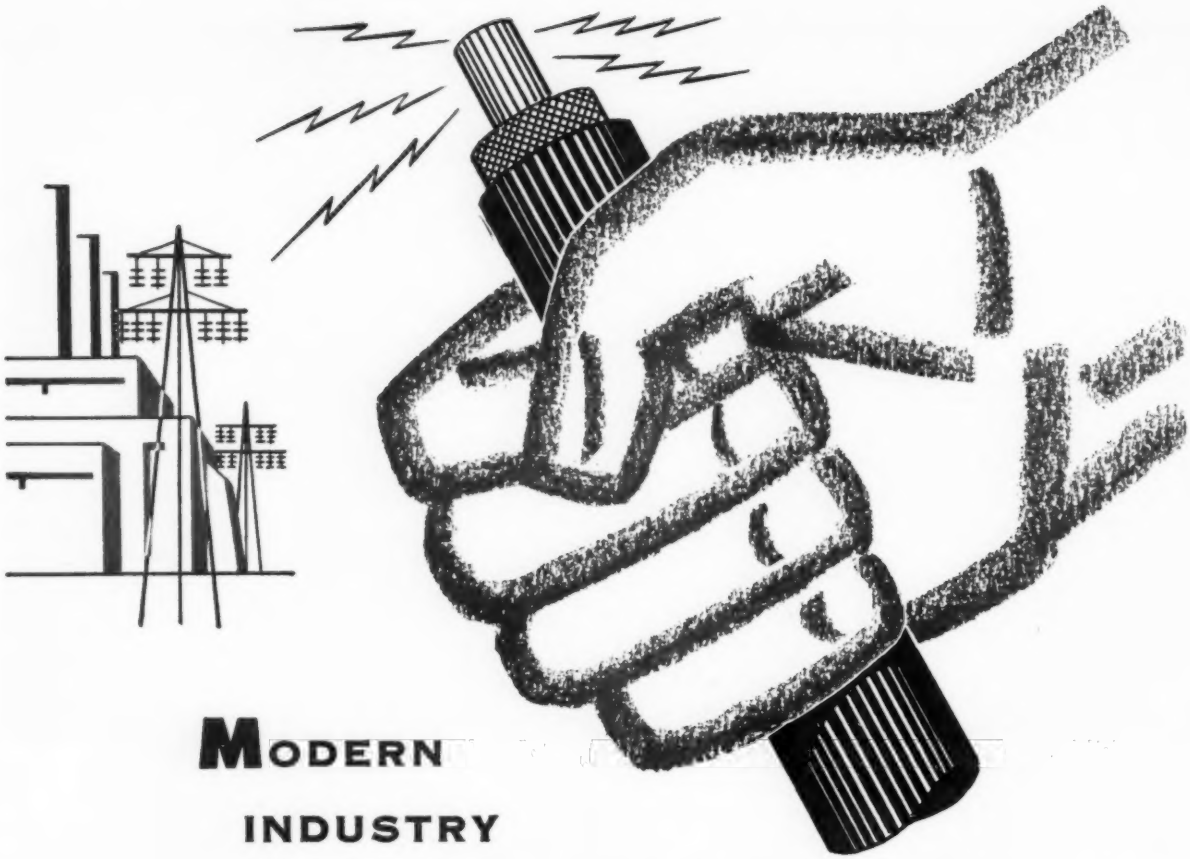
For maximum efficiency and performance, the entire plant is under automatic control. Steam pressure at the turbine is maintained constant and combustion is held at maximum efficiency for steam loads varying from 40,000 lb. per hr. to 165,000 lb. per hr. Both the Automatic Combustion Control System and the pressure reducing and desuperheater station were furnished by REPUBLIC FLOW METERS CO.

ONE OF MANY

This is but one of many power plants that rely on REPUBLIC Instruments and Controls. For more than 37 years, REPUBLIC has specialized in the design and manufacture of automatic control systems for all sizes of power generating stations. REPUBLIC Controls are available for all types of boilers and auxiliary equipment, all kinds of fuel firing (both for single or multiple fuels) and for all load fluctuations. When you specify REPUBLIC Controls, you get the benefit of this complete line of equipment and the services of an experienced engineering staff who know how to put that equipment to use to give you the control system that best meets your requirements.

For complete information about REPUBLIC Automatic Control Systems, send for Data Book S-21 or contact our field engineer nearest you. There's no cost or obligation.

REPUBLIC FLOW METERS CO. ● 2240 DIVERSEY PARKWAY • CHICAGO 47, ILLINOIS



MODERN INDUSTRY CHOOSES PRITCHARD EFFICIENCY

The plans of farsighted industrial leaders stress one vital need—increased efficiency from their power generating facilities. In some fields, more efficient operation requires extensive modernization. In others, necessary expansion is planned. Whatever the need, these men know they can rely on Pritchard for the modern facilities they require.

For more than a quarter of a century, corporate utilities and large industrial users of electric power, diesel power and steam have chosen Pritchard for generating stations, alterations and expansions to deliver maximum efficiency at lowest cost.

Your plans for modernization or expansion of your power plant will be more successfully completed if you take advantage of Pritchard's long experience, proved ability and *complete* design, engineering and construction facilities. For complete information, write today . . . your inquiry will receive immediate attention.

Industry's Partner for Progress

Serving the Gas, Power, Petroleum and Chemical Industries

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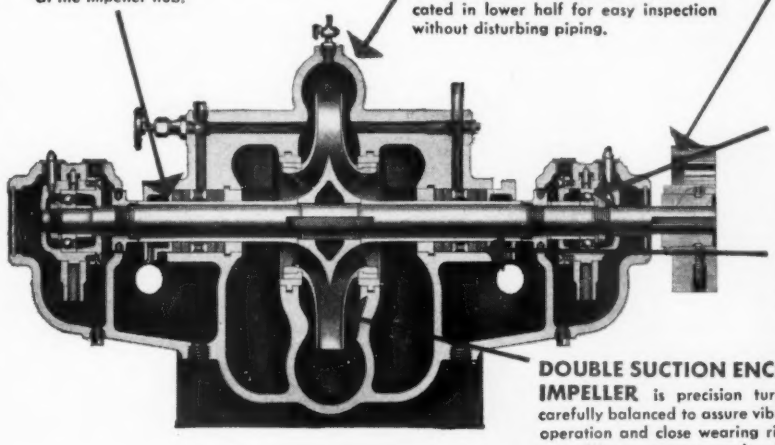
Representatives in Principal Cities from Coast to Coast

Look for These 7 Signs of GOOD PUMP DESIGN

CAST SHAFT SLEEVES, not commercial tubing, save the shaft from wear. Sleeves extend through the stuffing box and seal at the impeller hub.

HEAVY HORIZONTAL SPLIT CAST-IRON CASING construction with suction and discharge nozzles located in lower half for easy inspection without disturbing piping.

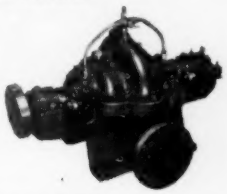


COUPLINGS have *Magic-Grip* quick change bushings for pump and drive shaft. Pin and rubber bushing type usually used. Removal for maintenance is easy.

BALL BEARINGS may be furnished for either oil or grease lubrication. Sleeve bearings also available in larger sizes.

GENEROUS STUFFING BOX LENGTH contains sufficient packing to keep stuffing box maintenance low. Provision is made for sealing water connections or for grease seal if these are required.

DOUBLE SUCTION ENCLOSED IMPELLER is precision turned and carefully balanced to assure vibrationless operation and close wearing ring clearance. Water passages are hand finished to a smooth surface.



STANDARD AND SPECIAL MATERIALS are available for many types of service where government regulations permit. Iron, bronze, stainless steel and combinations of these materials handle both alkaline and acid solutions. Standard sizes carried in stock range from 10 to 7000 gpm with heads as high as 475 feet.

THESE DESIGN AND CONSTRUCTION features of Allis-Chalmers double suction pumps assure long pump life and low maintenance costs. Every A-C double suction pump is carefully tested on the most modern pump testing equipment in the industry.

Complete Pumping Unit

Allis-Chalmers can furnish the complete pumping unit — pump, motor, control and drive — all of coordinated design and manufacture.

Whatever your pumping problem, call your nearby Allis-Chalmers Authorized Distributor or District Office. Or write for Bulletin 08B6146. Allis-Chalmers, Milwaukee 1, Wisconsin.

A-3952

Texrope, Magic-Grip, and Vari-Pitch are Allis-Chalmers trademarks.

ALLIS-CHALMERS

Sold . . .
Applied . . .
Serviced . . .

by Allis-Chalmers Authorized Distributors, Certified Service Shops and Sales Offices throughout the country.

MOTORS — ½ to 25,000 hp and up. All types.

CONTROL — Manual, magnetic and combination starters; push button stations and components for complete control systems.

TEXROPE V-belts in all sizes and sections, standard and *Vari-Pitch* sheaves, speed changers.

Combined trip-throttle valve permits operator to throttle steam directly into G-E Type DP Mechanical-Drive Turbine, usually eliminating need for extra valve in steam line.

ANOTHER PLUS VALUE OF G-E MECHANICAL-DRIVE TURBINES...

Combined Trip-throttle Valve Cuts Turbine Installation Costs

To save you the cost both of buying and installing a throttle valve in the steam line, General Electric designed into its standard Type DP mechanical-drive turbine a trip valve which also functions as a throttle valve. This feature alone can save you up to $200.00 at time of installation.

The combined trip-throttle valve controls steam admission to the turbine on starting and also shuts off all steam in case of overspeed. No need in most cases to shut off steam valves ahead of the turbine before restarting the unit. The combined trip-throttle valve can quickly be reset and the turbine put back on the line, saving you time in an emergency.

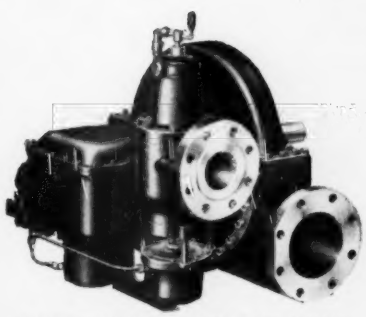
THIS COMBINED TRIP-THROTTLE VALVE is just one of many DP features which save you money. The chart below indicates other areas of savings.

Remember—the total cost is often more than just the sales price. But G.E.'s standard DP turbines include the extra features to save you extra costs. For more information contact your nearest G-E apparatus sales office. Write for bulletin GEA-4955A, "A New Standard in Mechanical-drive Turbines." General Electric Company, Schenectady 5, N. Y. 252-63

GENERAL ELECTRIC

INSTALLATION AND MAINTENANCE COST-SAVING FEATURES

THESE EXTRA FEATURES, STANDARD ON ALL G-E TYPE DP TURBINES, CAN . . .	Save You up to
COMBINED TRIP-THROTTLE VALVE Eliminate extra cost of buying and installing valve ahead of the turbine.	$200.00
SINGLE RESERVOIR FOR COOLING LUBE OIL Eliminate extra cost of piping cooling water to and between bearings.	50.00
MAJORITY OF PARTS INTERCHANGEABLE One set of spare parts protects several units—less money tied up in inventory.	100.00
METALLIC-LABYRINTH VALVE STEM BUSHING Eliminate labor costs of replacing soft packings; cut down-time production losses.	50.00
SHAFT MONEL-SPRAYED AT PACKING FIT Saves frequent cost of purchasing and installing carbon rings; contributes to long shaft and packing life.	20.00
ESTIMATED TOTAL SAVINGS	$420.00

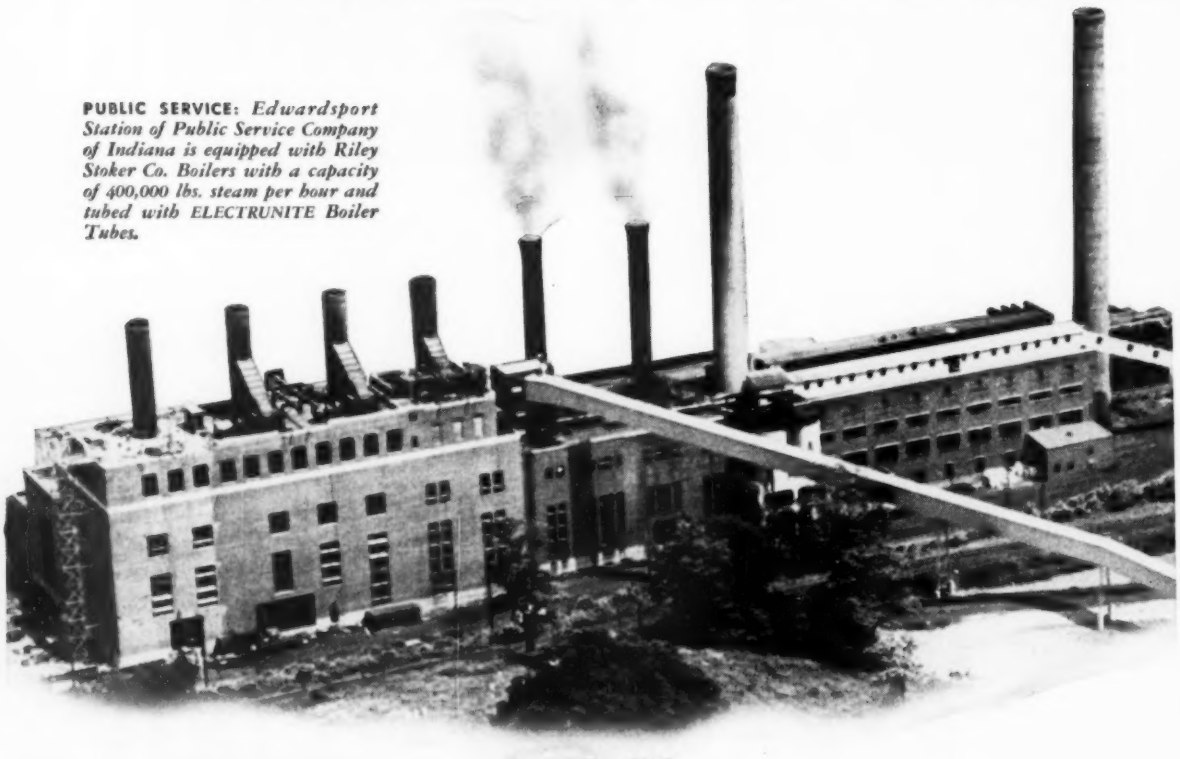


G-E Type DP Mechanical-Drive Turbine

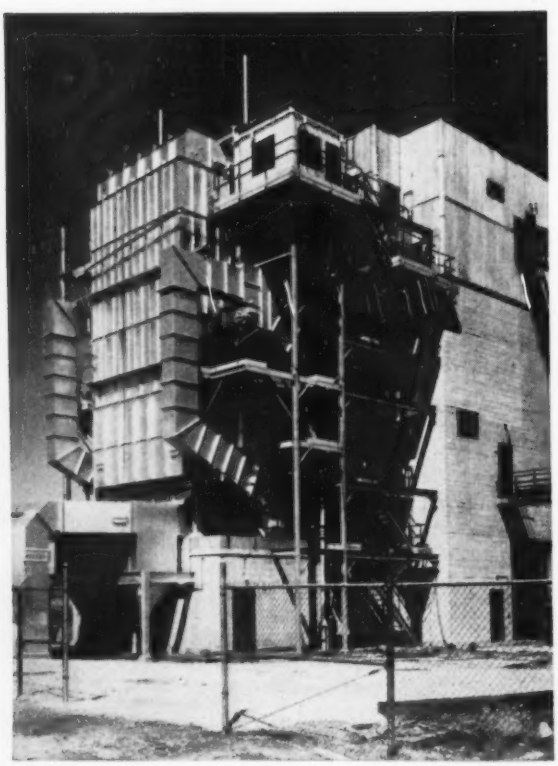
COMPARE THE FEATURES
EVALUATE ALL THE COSTS

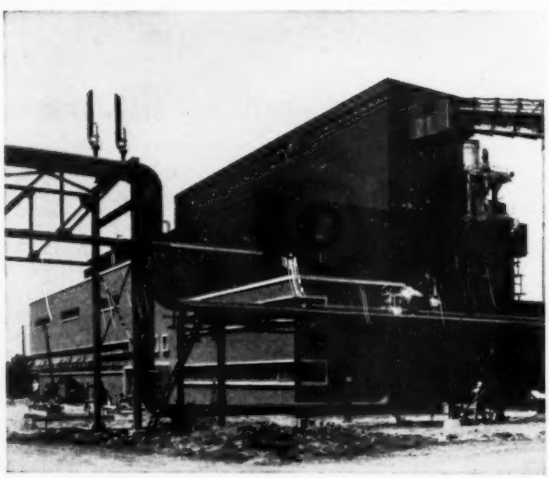
See why G-E standard Type DP turbines are your most economical buy.

ALL these JOBS have



PUBLIC SERVICE: *Edwardsport Station of Public Service Company of Indiana is equipped with Riley Stoker Co. Boilers with a capacity of 400,000 lbs. steam per hour and tubed with* ELECTRUNITE *Boiler Tubes.*

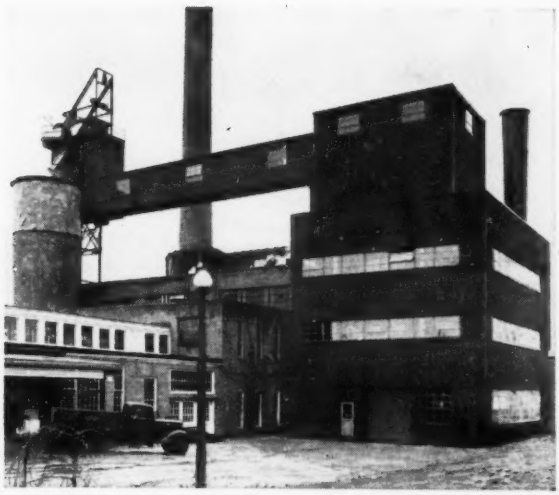




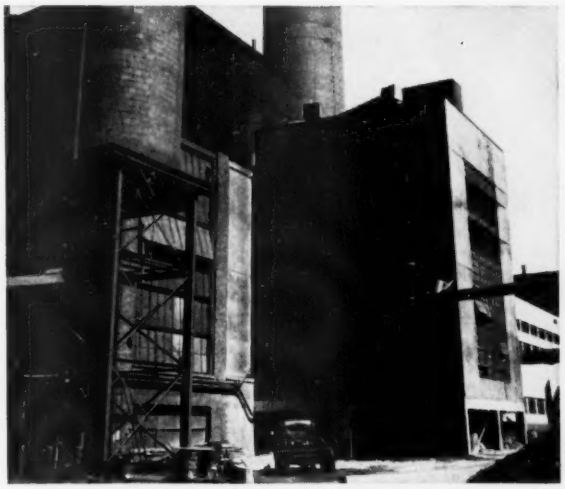
PETRO CHEMICAL PLANT: *The new boiler house at National Petro-Chemicals plant, Tuscola, Illinois, will house three Combustion Superheater Engineering boilers with a continuous capacity of 200,000 pounds of steam per hour.*

PUBLIC UTILITY: *Out-of-doors installation of Riley Stoker boiler to new 12,650 k-w extension at Superior, Wisconsin. Republic* ELECTRUNITE *Boiler Tubes are used to help release 12,800 btu. per hour in the 12,000-cubic-foot furnace.*

ELECTRUNITE Boiler Tubes



MUNICIPAL LIGHT PLANT: *A recent installation of a 475 P.S.I., 750°, 75,000 lbs., steam per hour unit at the Municipal Light Plant, Orrville, Ohio, where* ELECTRUNITE *Boiler Tubes are used in Riley Stoker Boilers.*



INDUSTRIAL PLANT: *At B. F. Goodrich plant, new Riley Stoker boiler tubed with* ELECTRUNITE *Boiler Tubes is installed in this addition to the power house.*

These are only a few of the many installations, both large and small, for which ELECTRUNITE Boiler Tubes were chosen. Here are the reasons why more than 250 million feet have been used throughout all industry:

1. ELECTRUNITE Boiler Tubes are made from flat-rolled steel, carefully inspected on both surfaces before forming.

2. Walls of tubes are uniform thickness, making heat transfer uniform all around the tube and from end to end.

3. Full-normalizing makes ELECTRUNITE Boiler Tubes uniformly ductile for smooth bending and roller expanding, and also provides a scale-free surface. That means no grinding tube ends before inserting into headers or boiler drums.

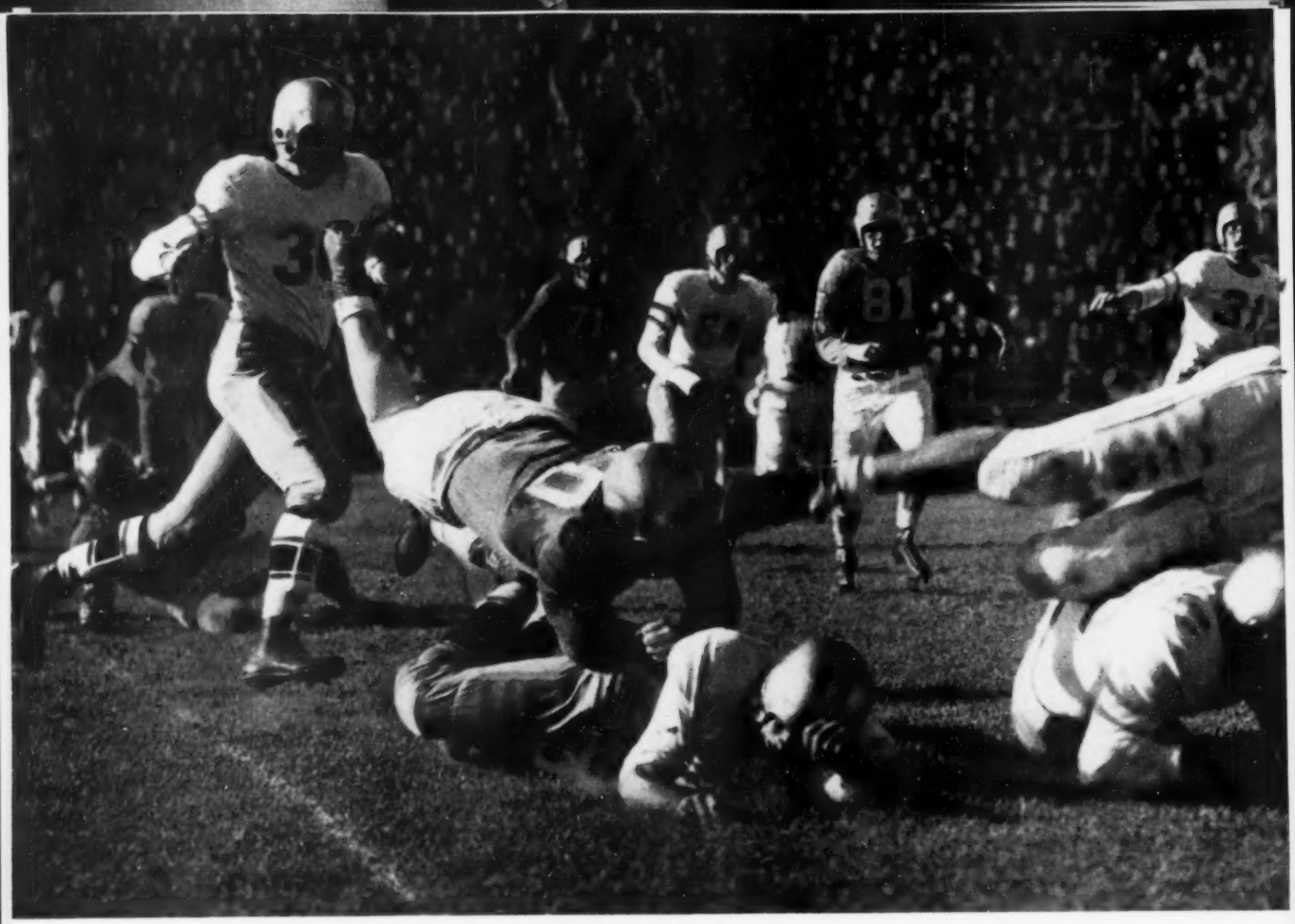
These advantages add up to faster, easier installation and long service life in countless types of steam generating and heat transfer equipment. Write for complete information about the ELECTRUNITE process and ELECTRUNITE pressure tubes.

STEEL AND TUBES DIVISION
REPUBLIC STEEL CORPORATION
221 East 131st St. • Cleveland 8, Ohio
Export Department:
Chrysler Building, New York 17, N. Y.

REPUBLIC STEEL

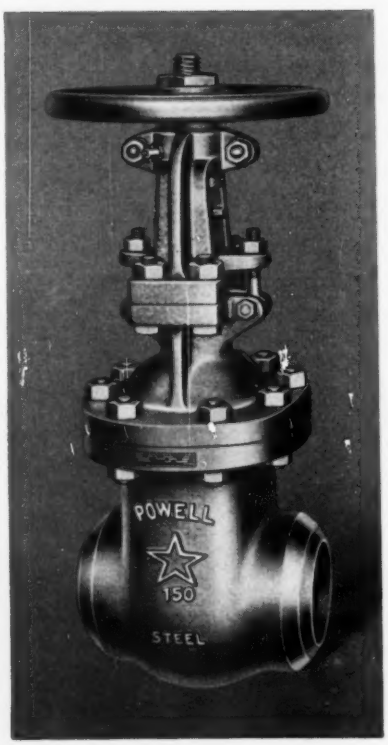
Republic
ELECTRUNITE
BOILER, CONDENSER AND HEAT EXCHANGER TUBES

ELECTRUNITE means ELECTRically UNITEd

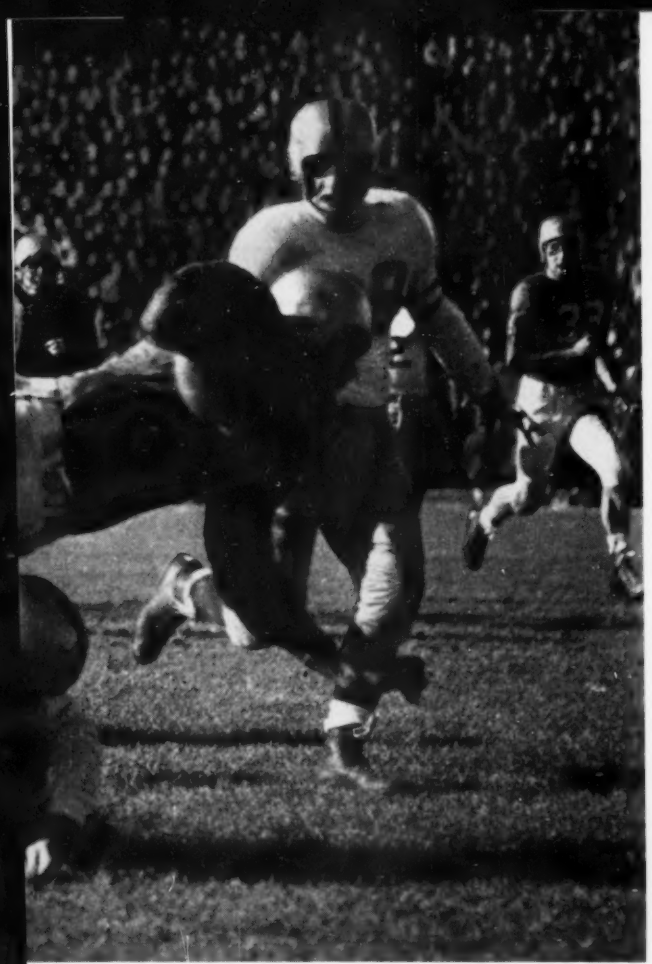


WELDING END CAST STEEL GATE VALVE *(Fig. 1503 W.E.)* 150 pounds. Bolted flanged bonnet with outside screw rising stem and yoke. Available in sizes 1″ to 30″, inclusive.

WELDING END CAST STEEL SWING CHECK VALVE *(Fig. 3061 W.E.)* 300 pounds. Bolted flanged cap. Heavy rugged construction. Available in sizes 1″ to 12″, inclusive.



BRONZE "W.S." FULL FLOW GLOBE VALVE *(Fig. 2608)* for 200 pounds W.P. Regrindable, renewable, hardened stainless steel seat and disc. Nominal pipe size opening through seat permits fuller flow, with pressure drop and turbulence cut to minimum.



STAR PERFORMERS

From coast to coast, Powell Valves have won enthusiastic approval. For *every* Powell Valve is a *star for outstanding performance.* They have a record of dependability since 1846.

Small wonder that Powell Valves have made such a hit through the years. Powell has probably done more valve research, solved more valve problems and makes more types of valves than any other organization in the world.

We're sure that *you* will be enthusiastic about Powell Valves too once you see how they perform. Following are just a few members of the Powell all-star cast of valves which are available through distributors in principal cities. If a distributor is not located near you, just write us. We'll be pleased to tell you more about these valves—and our complete line.

PRESSURE SEAL CAST STEEL GATE VALVE *(Fig. 11303)* 1500 pound. Many proven advantages and exclusive features. Pressure Seal, Non-Return, Check, Globe and Angle valves also available.

INTEGRAL BONNET CAST STEEL "Y" VALVE *(Fig. 1314-A)* 1500 pound. The one-piece construction eliminates possibility of leakage between body and bonnet. Sizes ½" to 2", inclusive.

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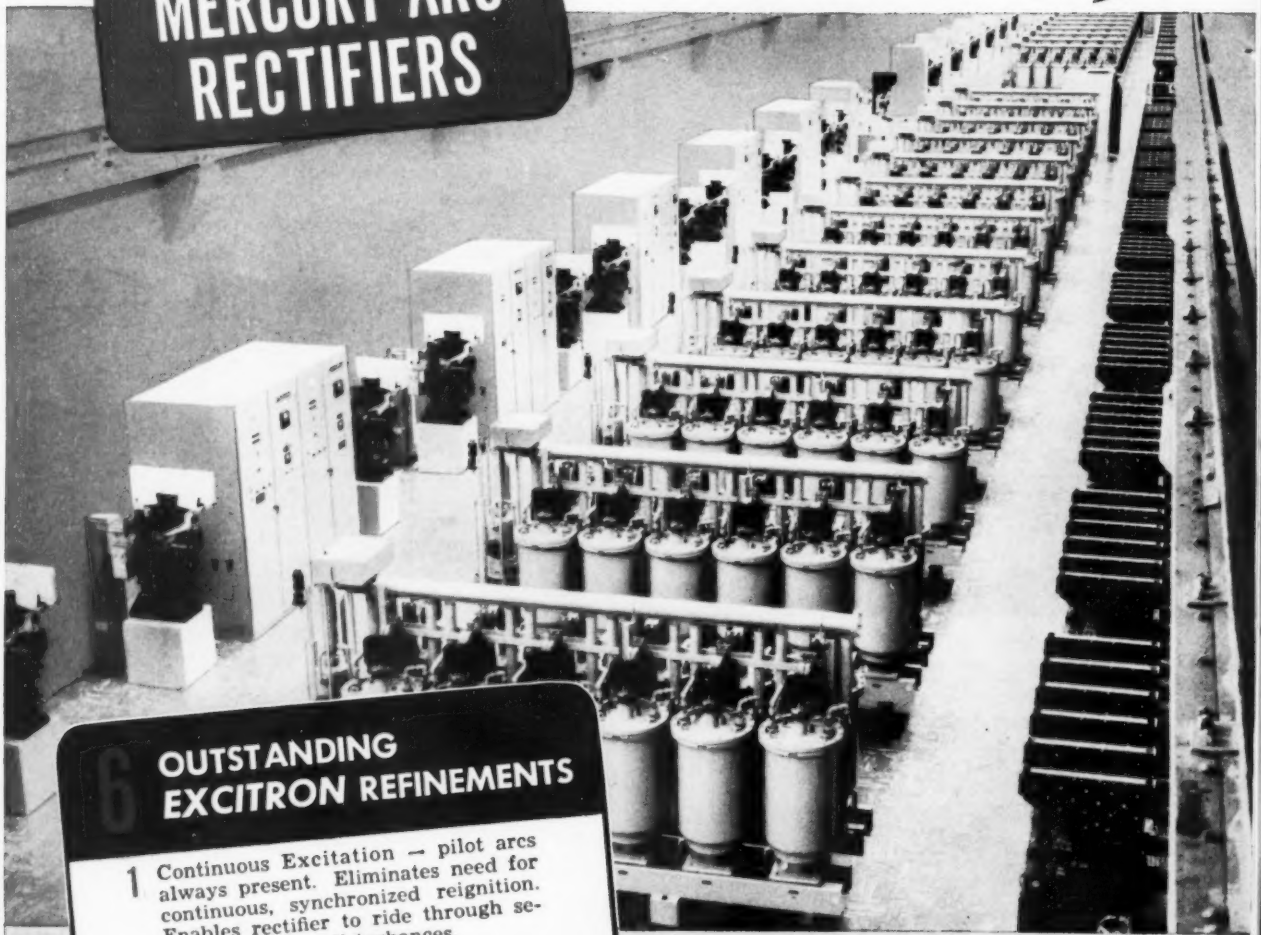
ALLIS-CHALMERS MERCURY ARC RECTIFIERS



6 OUTSTANDING EXCITRON REFINEMENTS

1. Continuous Excitation — pilot arcs always present. Eliminates need for continuous, synchronized reignition. Enables rectifier to ride through severe ac voltage disturbances.
2. Fixed Excitation Anode — doesn't contact cathode mercury and is independent of level, turbulence or impurities . . . requires no adjustment, maintenance or replacement.
3. Internal Cooling System — high heat transfer with seamless-tube cooling coil located within the rectifier.
4. Enameled Anode Seals — multi-layer fused vitreous construction provides high-strength seal unaffected by thermal variation.
5. Grid Phase Control — in cleaner region near anode, where ion density is lowest.
6. Arc-over Free Tube — insulating entire arc path eliminates danger of arcing-over to tube.

A view of the rectifier room at ALCOA's Wenatchee plant. Shown are twenty-four 6000-amp, 750-volt rectifier assemblies connected in pairs to twelve 10,000-kva outdoor rectifier transformers. Each transformer and two rectifier assemblies form a 9000-kw conversion unit.

At the left are cathode breakers and rectifier control cubicles — on the right, high speed anode breakers.

ALLIS-

000 kw
of Reliable DC Power

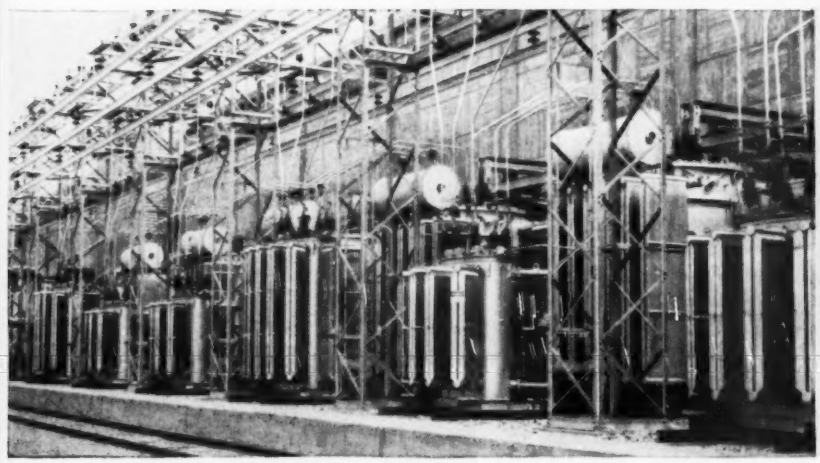
Allis-Chalmers **Excitron** Rectifiers Provide Dependable, Efficient Power Conversion for Newest ALCOA Plant

AT THE RECENTLY COMPLETED WENATCHEE, WASHINGTON PLANT of the Aluminum Company of America, A-C *Excitron* mercury arc rectifiers are providing dependable and efficient power conversion for smelting of aluminum oxide into aluminum.

The aluminum smelting process requires dependable dc power 24 hours a day. Any interruption in this power supply can cause freezing of the molten metal, resulting in serious damage and production loss. And because 9 to 10 kwhr of dc power are required for production of each pound of aluminum, high conversion efficiency is essential for low cost aluminum oxide smelting.

Allis-Chalmers *Excitron* rectifiers are designed and engineered for dependable and efficient operation in every type of industry. They combine the high service reliability, efficiency and low maintenance characteristics of mercury arc rectifiers with additional A-C refinements . . . Continuous Excitation, Fixed Excitation Anode, Internal Cooling System, Enameled Anode Seals, Grid Phase Control, Arc-over Free Tubes.

Whatever your power conversion requirements may be, you can rely on A-C mercury arc rectifiers for dependable and efficient service. For complete information on Allis-Chalmers rectifiers for your plant, contact your nearest A-C sales office or write Allis-Chalmers, Milwaukee 1, Wisconsin. A-4156



A part of the outdoor transformer yard showing 10,000-kva rectifier transformers and phase shifting autotransformers which produce a 36-phase system. Main 13.8-kv, 3-phase aluminum I-beam section busses supplying all transformers are suspended from crossarms of superstructure with air-break disconnecting switches mounted on top.

CHALMERS

A-C ALLIS CHALMERS

Our Engineers Introduced Mercury Arc Rectifiers to U. S. Industry

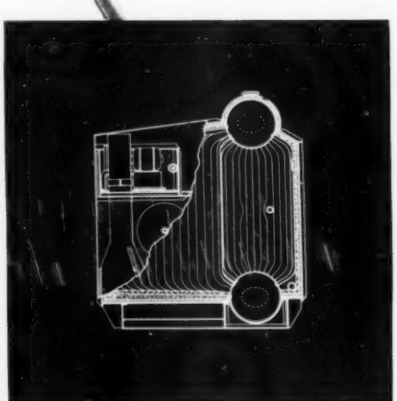
Which C-E Boiler meets YOUR steam needs best?

These four C-E Boilers have been specifically designed to meet the requirements of a wide variety of plants. Collectively, they offer you a range of capacities from 4,000 to 350,000 pounds of steam per hour... pressures up to 1375 psi... temperatures to 960 F... arrangements for any fuel or method of firing.

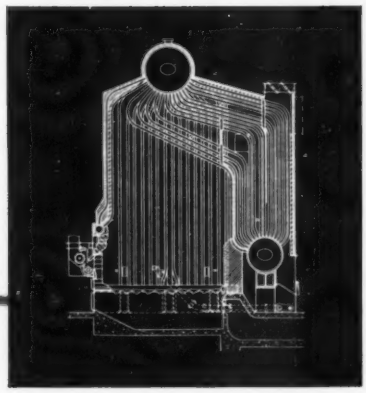
Two of these units, the VP and the VU-10, are fully standardized. Each of the other two has been standardized as far as is practical for its particular field of application. Thus, all four units reflect in purchase price minimum engineering costs made possible by maximum design standardization.

It's small wonder, then, that industries of all kinds have demonstrated widespread acceptance of C-E Industrial Boilers. The low steam costs and top reliability of these Combustion Boilers can be your guide, too, to the maximum return on your new boiler investment. B-703

C-E Package Boiler — Type VP The VP Boiler is designed to meet the demand for compact, standardized units in the medium pressure range. It is shipped completely shop-assembled, with firing equipment, fittings, and forced-draft fan. It is enclosed in a reinforced, welded steel, gas-tight casing. Arranged for pressure firing of oil or gas, the VP will burn either fuel exclusively or alternately. Designed for shipment by rail or truck, its width and height remain constant... variations are made in length only. Furnace is fully water-cooled, including burner wall, except in three smallest sizes. Large lower drum permits simple, symmetrical tube arrangement and greater water storage capacity.

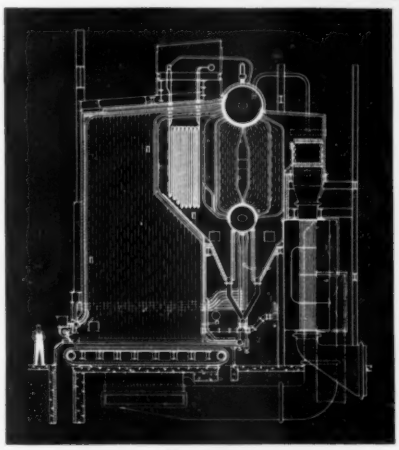


Type VP Boiler — from 4,000 to 30,000 lb steam per hr . . . pressure to 250 psi . . . available for either gas or oil firing . . . fully shop-assembled.



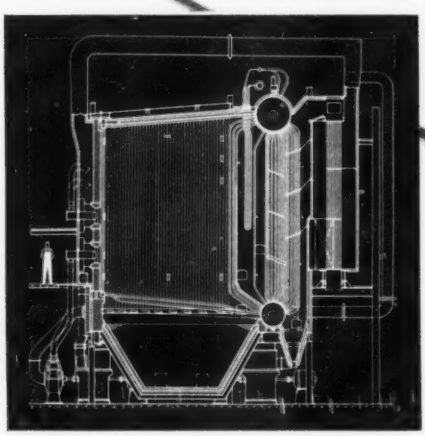
C-E Vertical-Unit Boiler — Type VU-10 Like the Type VP Package Boiler, the VU-10 is designed for plants having a limited number of operating and maintenance personnel. It is designed for industrial load conditions and will operate efficiently over a wide range of output. The boiler is bottom supported and has no outside supporting steel. The same general cross-section arrangement of drums, boiler convection bank, and furnace wall cooling is used when firing oil, gas or coal. Coal firing may be with underfeed, spreader, or chain grate stokers.

Type VU-10 Boiler — From 10,000 to 60,000 lb steam per hr . . . pressure to 475 psi . . . superheat to 200 F . . suitable for any type of fuel.



C-E Vertical-Unit Boiler — Type VU-40 The VU-40 Boiler is a baffleless boiler designed for use with fuels having abrasive qualities in the flue dust. In a baffled boiler using these abrasive fuels, erosion is apt to occur. In the VU-40 Type Boiler, the eroding action of abrasives against boiler tubes and refractory is virtually eliminated. Like the VU-10 and VU-50, this unit is of symmetrical design, providing uniform gas flow and heat absorption across the full width of the boiler.

Type VU-40 Boiler — from 60,000 lb steam per hr up . . . pressure to 1375 psi . . . temperature to 960 F . . . for use with abrasive or high ash content fuel . . . indoor or outdoor type construction.



C-E Vertical-Unit Boiler — Type VU-50 With the VU-50 Boiler, the average plant can achieve standards of performance closely approaching those of large central power stations. The basic design was originated by Combustion in 1925 and has been widely accepted among steam-power engineers everywhere. Because of its symmetrical design the VU-50 provides uniformity of gas flow, water level and steam release across the full width of the unit. It may be fired by pulverized coal as shown opposite or by any other fuel or method of firing. Heat recovery equipment may be added.

Type VU-50 Boiler — from 60,000 to 350,000 lb steam per hr . . . pressure to 1375 psi . . . temperature to 960 F . . . for any fuel or method of firing . . . indoor or outdoor type construction.

COMBUSTION ENGINEERING, INC.

Combustion Engineering Building • 200 Madison Ave., New York 16, N. Y.

ALL TYPES OF STEAM GENERATING, FUEL BURNING AND RELATED EQUIPMENT

This "FF" explosion cost

Famous City Hall "Blows its Top"
A burner Flame-Failure ("FF") explosion literally blew the roof off of the famous city hall at [redacted], causing $55,000 damage and disrupting government.
Such explosions occur when burner flames fail and shut-down of fuel is not immediate. In a few seconds, still-flowing fuel forms dangerous gases which ignite explosively on hot fire brick.

COVERING THE U.S.A. — and Canada, factory-trained field engineers provide "know how" of flame failure safeguarding with FIREYE.

$55,000...

It could happen to you...

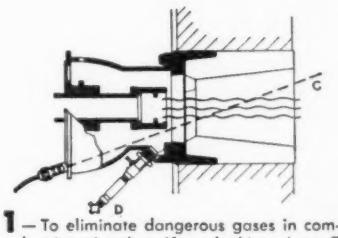
IT COULD HAPPEN, and it could be costly if your present "safeguard" responds slowly.

Today, insurance companies require automatic safeguards for commercial and industrial burners to shut off fuel in 2 to 4 seconds after a burner Flame Failure (FF). Relatively few flame failure safeguards now in use can satisfy that requirement. Most of them actually require more than a minute for response. If your safeguard is that slow, you may be relying on no protection at all!

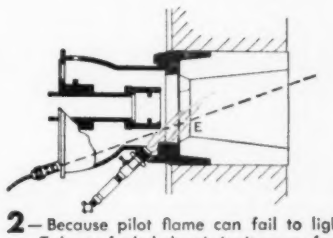
Don't delay in replacing slow, half-safe controls with the modern, fully-approved FIREYE System . . . the only *complete* and instantaneous safeguard for all types of fuels. With FIREYE, an electronic "eye" works with the speed of light when a burner flame goes out, to cut off fuel and signal operating personnel.

Thousands of installations prove FIREYE has no equal for reliability and effectiveness. Can be applied to oil, gas, coal burners "overnight" — for a negligible investment.

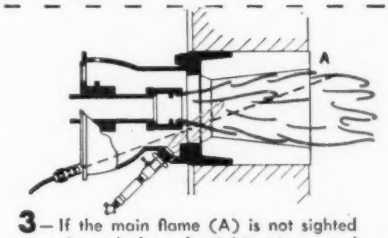
How fireye works to give you complete flame failure protection...



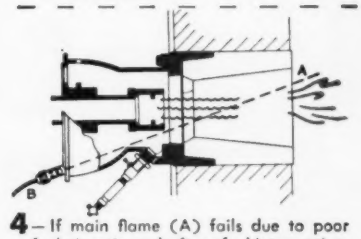
1 — To eliminate dangerous gases in combustion chamber (from leaking shut off valve during down time of burner,) FIREYE purges chamber (C) before igniting pilot (D).



2 — Because pilot flame can fail to light off due to fouled electric ignitors, no fuel, or poor fuel-air mix, FIREYE proves pilot flame (E) is proper before turning on main fuel valve.



3 — If the main flame (A) is not sighted at the end of a safe trial ignition period (due to no main fuel or poor fuel-air ratio or draft) FIREYE shuts down the burner.



4 — If main flame (A) fails due to poor fuel-air ratio or draft, or fuel interruption, FIREYE shuts down burner in 2 to 4 seconds to prevent explosion of unburned gases.

fireye®

UL FM

PLAY SAFE! SEND NOW!

This may be the most important book you ever read

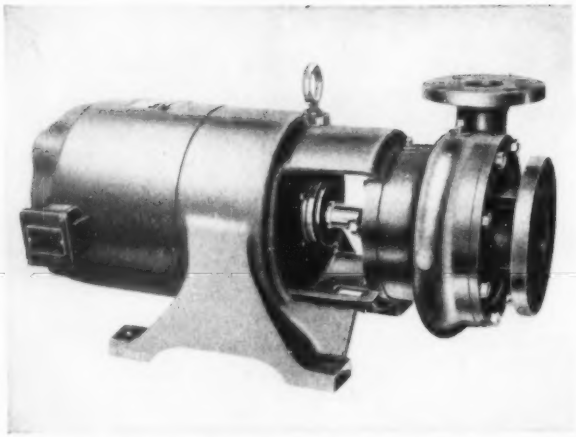
Why take chances? Even with modern power, processing or heating equipment, the chances are 4-to-1 you do not have complete flame failure safeguards. Send for this new "primer" on flame failure explosion hazards. It tells how you can simply check the protection you now have, and what you need. Use the coupon below.

COMBUSTION CONTROL CORP.,
Dept. PB-11, 718 Beacon St., Boston, Mass.
Send me your free booklet
"Guarding Your Properties Against Flame Failure Explosions".

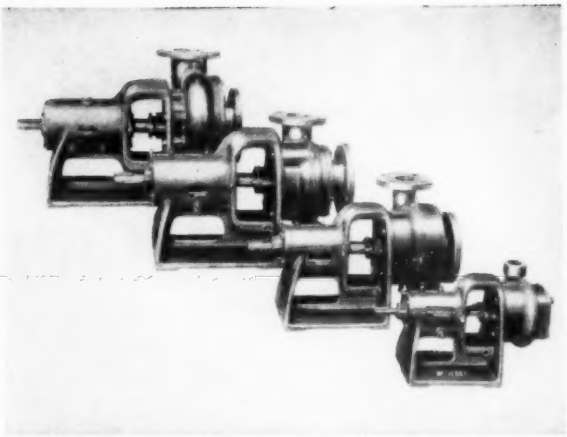
Name ..... **(Title)** .....

Firm .....

Address .....

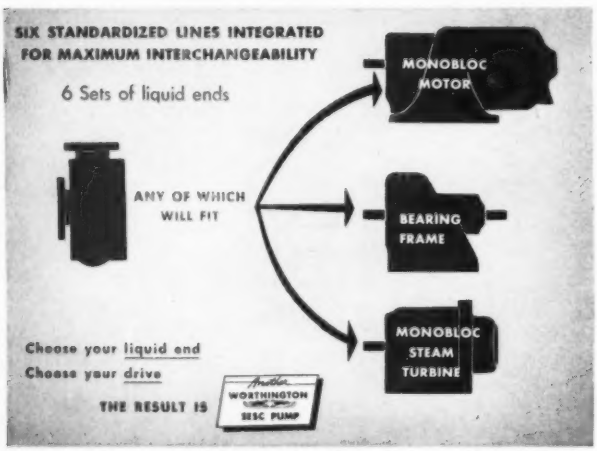


WITH BUILT-IN MOTOR—Well known throughout industry is this compact streamlined Worthington Monobloc centrifugal pump. Worthington SESC standardization makes it possible to interchange any of six sets of liquid ends to the motor housing.



FOR ANY CONVENIENT DRIVE—Frame-mounted units are available in four frame sizes. Like the Monoblocs, they use the same six sets of liquid ends and either conventional packing or a standardized mechanical seal that is readily changed in the field if necessary.

Why Worthington's SESC* pump line means greater availability, broader selection, easier servicing



STANDARDIZATION of *parts*, *mountings*, *materials* and *dimensions* virtually eliminates the necessity of slow and expensive custom manufacture to meet special pumping requirements. From 650 parts within its six standardized sets of liquid ends, Worthington can assemble 60,000 *different* standard pumps! C-3.1

Greater availability because the new Worthington pump line will handle more requirements with a *standard*, readily obtainable unit.

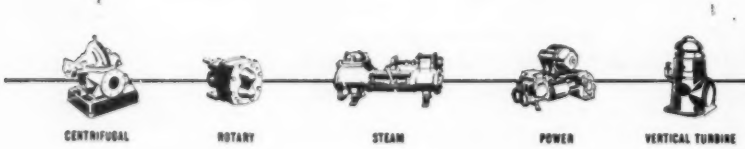
Broader selection because of the complete range of ratings and special design features in the 60,000 different SESC pumps.

Easier servicing because standardized parts mean lower parts-inventory requirements.

This sums up the advantages you can expect when you use Worthington standardized centrifugal pumps. The SESC line is Worthington's latest move towards assuring you the *right* pump for the job.

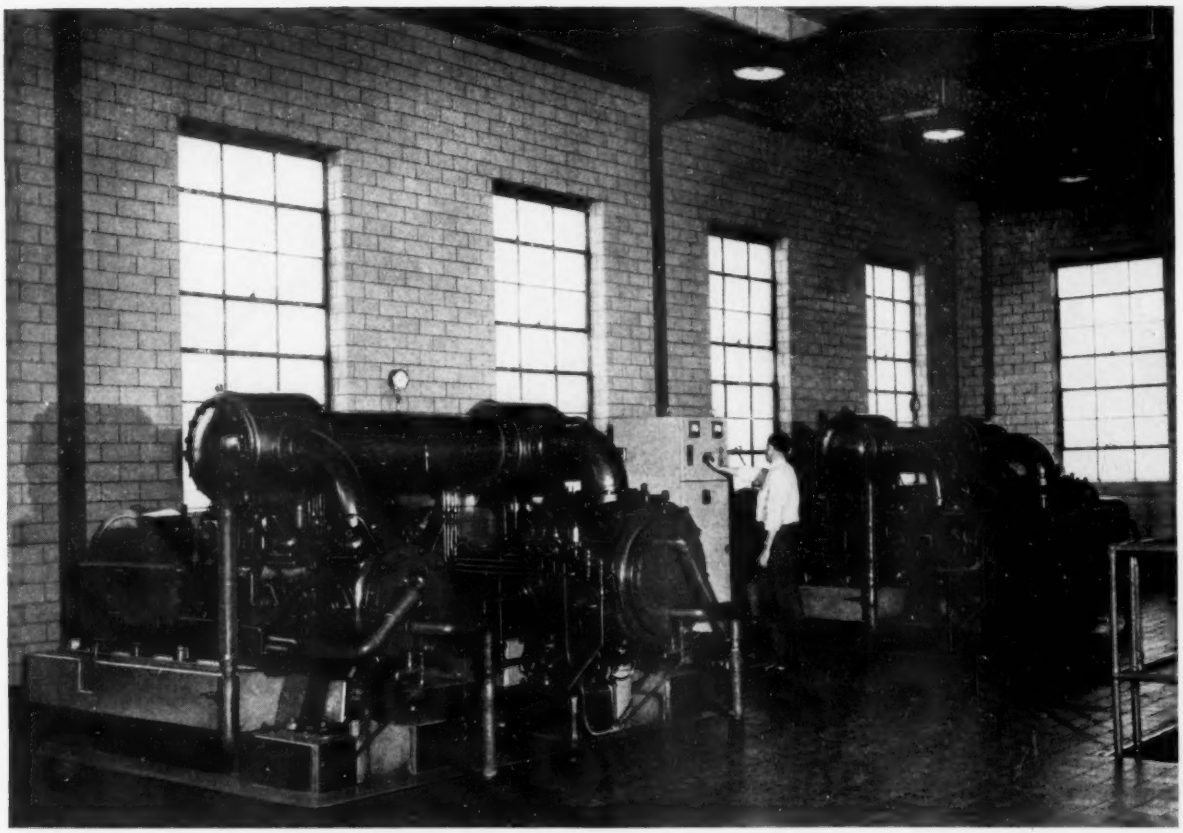
For more information, contact your local Worthington distributor or write for Bulletin W300 B-4 to Worthington Corporation, Centrifugal Pump Division, Harrison, New Jersey.

*Standardized End Suction Centrifugal

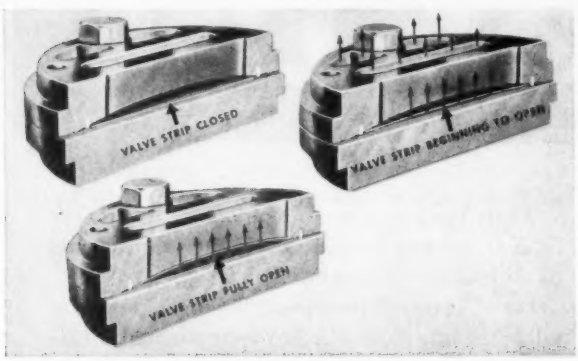


The World's Broadest Line Assures You The Right Pump For Every Job

WORTHINGTON
Centrifugal Pumps



PERFECTION STOVE'S ULTRA-MODERN POWER PLANT is equipped with two Worthington DC-2 air compressors, each with a capacity of 1000 cfm.



QUIET-OPERATING WORTHINGTON FEATHER* VALVE is made up of a series of thin flexible strips of ribbon steel, held in position over rectangular openings by curved milled guards. The valve strips lift and flex uniformly against the curved guards. In addition to quiet operation, the absence of impact results in long valve life and low maintenance costs.

Perfection called for the finest in air compressors

• The Perfection Stove Company's new Ivanhoe Road power house in Cleveland has received national recognition as a leading example of modern, medium-size power plant design.

Every piece of equipment in this million-dollar plant had to meet the rigid specifications of Perfection's engineers. That's why, when it came time to supply compressed air for general plant use, two Worthington DC-2 horizontal air compressors were selected.

By installing these modern Worthington compressors, Perfection engineers made sure they would get lowest-cost compressed air and longest compressor life. The exclusive Worthington Feather* Valve—the lightest, tightest, most efficient valve made—is largely responsible for that.

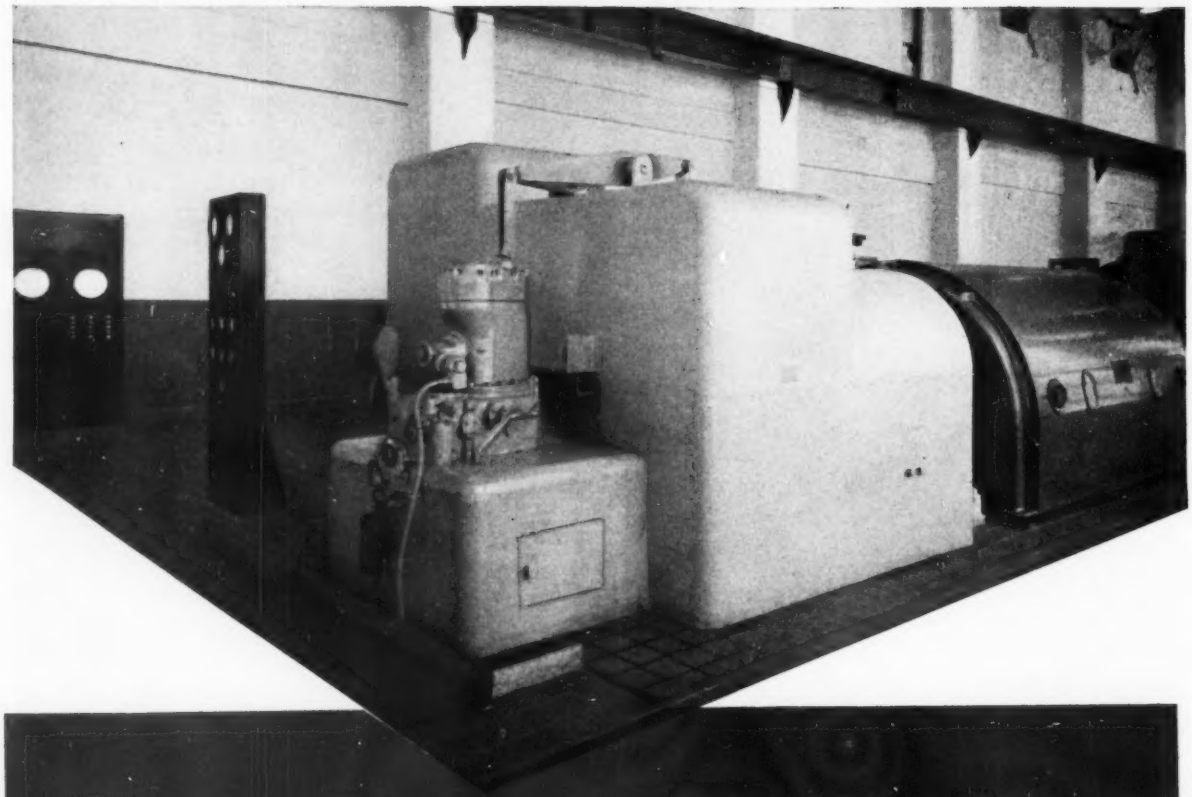
Take a tip from Perfection Stove and find out for yourself about the Worthington line of air compressors. Write to Worthington Corporation, Compressor Division, Section K.3.7, Buffalo, N. Y. *Reg. U. S. Pat. Off.*

K.3.7

WORTHINGTON

Only Worthington Compressors give you Feather Valve Performance

Y-Types • Balanced Angle • Horizontal • Portable • Radial • Gas Engine Compressors



How to keep a turbine system CLEAN FOR LIFE

LUBRICATE with the oil especially refined to prevent sludge, rust and foam—*Texaco Regal Oil (R & O).* Tests prove that *Texaco Regal Oil (R & O) has more than ten times the oxidation resistance of ordinary turbine oils.*

With *Texaco Regal Oil (R & O)* turbine systems stay clean throughout the extra-long service life of this oil. Thus there is uninterrupted flow of clean, cooling lubricant to maintain normal bearing temperatures and assure instant governor response.

There is a complete line of *Texaco Regal Oils (R & O)* to meet the most stringent requirements of all leading turbine builders.

Let a Texaco Lubrication Engineer help you select the one best suited to your particular turbines and operating conditions. Just call the nearest of the more than 2,000 Texaco Distributing Plants in the 48 States, or write:

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The Texas Company, 135 East 42nd Street, New York 17, N. Y.

TEXACO

TEXACO Regal Oils (R & O)
FOR ALL TURBINES

The New Technical Journalism

EVERY READER must be aware of the fact that POWER is never satisfied to stand still. We hope you see many evidences of constant pioneering—for example, radically new types of special sections, such as last year's on "Water" and Jim O'Connor's "Today's Electrical Practice," last month.

Yet, despite all the progress made to date, and despite the constant shucking of hoary traditions in our editorial pages, neither we nor anybody else has said the last word in technical journalism or found the best way to tell a practical engineering story. So experimentation and development must proceed endlessly in this field, just as it will in factory and power plant. We will find still faster and better ways to convey useful engineering information to our readers.

Yet rapid progress poses its own problems because we all have an important parallel stake in continuity. Neither the readers nor the editors want to see POWER turned upside down every month while this or that bright idea is tried out. So here's the practical problem: on the one hand, to be as progressive and creative as possible—on the other, to keep POWER always plowing ahead on an even keel.

We think we have found the answer to this problem. Each month now, in our editorial planning meeting, we pick out one outstanding article for radical experimentation. The editor handling the chosen article consults with the rest of us to get everybody's thinking on ways to put his story over. The aim is to give his article "the works," to spare nothing in money, time, space or effort to make it click in a super way.

We figure this will accomplish four things: First, it will add to the interest and usefulness of every issue. Second, it will give us a continuing opportunity to let our readers tell us how well they like various advanced ways of telling an engineering story. Third, it will give our editors valuable experience with new techniques. Fourth, it will do all this without endangering the enduring values that have been built into POWER through many decades of constant endeavor.

In addition to our regular monthly tests of reader interest, we shall welcome your special comments on these pioneer articles. For a starter, if you have a little time to spare, turn back to page 71 of August POWER and quickly review "Modernization Has to Be Sold." Note the complete break from the usual humdrum way of telling an engineering story. Do you like this particular departure from tradition? Does the unusual arrangement of writing and sketches make your reading quicker, more pleasant and more profitable?

Quite different, and a particularly tough assignment, was project No. 2—Ben Skrotzki's article on page 80 in September, on superpressure power plants. Here was a far more technical subject, requiring thermodynamic diagrams. Here again we ask you, the reader, whether the unusual treatment makes it easier for you to understand the peculiar nature and commercial potential of steam at pressures above 3206 psi absolute.

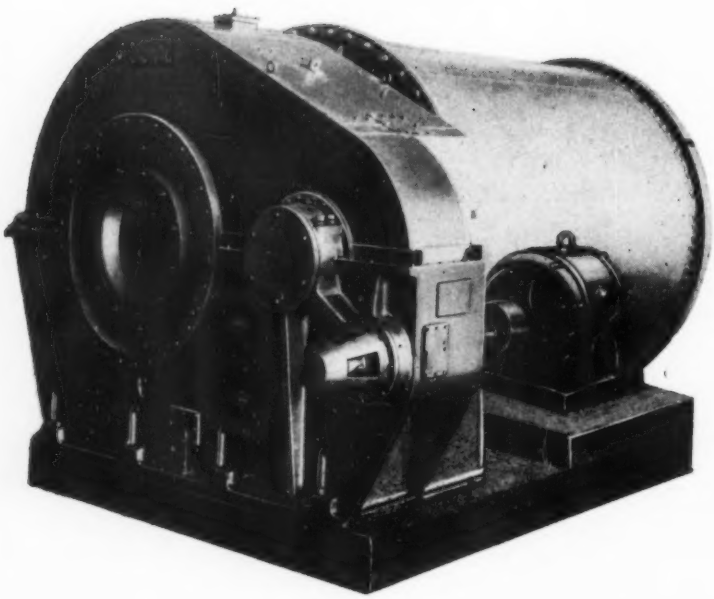
And now, finally, we hope you will turn to page 106 of this issue for project No. 3 and then follow through the most elaborate "Operators' Notebook" Steve Elonka has yet attempted—eight fast-moving pages of step-by-step picture instructions for overhauling a turbine.

It's my personal feeling, after studying the article very carefully in proof, that Steve's intensely practical slant on maintenance has here achieved a new high, but the final judgment is up to you, not to me. You are the customer for our editorial services. Is every step in this turbine overhaul perfectly clear to you? Is anything missing? Can you think of anything further that would have saved your time or increased your interest? Your comments will be appreciated.

We are lining up lots of interesting ideas for future issues of POWER—still other new ways to weave plain talk and plain pictures into still better service for engineers on the job. If you have suggestions, don't be bashful—*PWS*

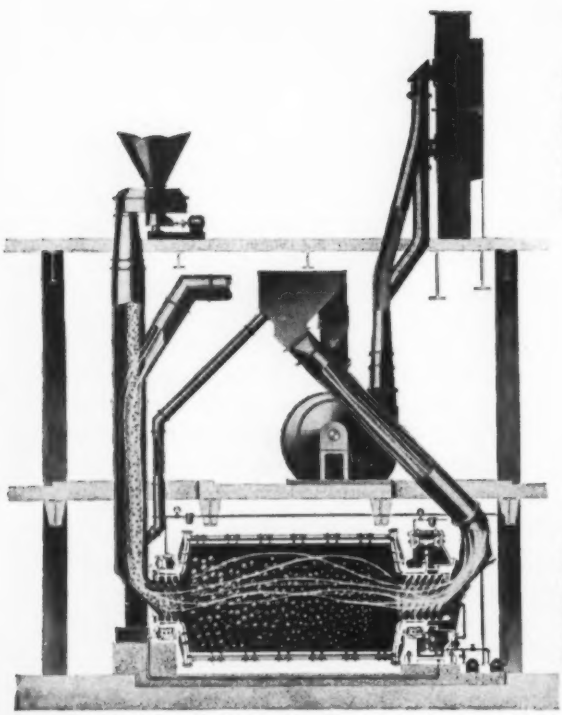
Save $1.00 per ton.....

...with the KENNEDY



INTEGRAL GEAR DRIVEN MILL

Slow-speed ball mill manufactured in large sizes producing up to 85 tons of pulverized coal per hour. Sturdy and reliable. Availability throughout the years over 99%. Grinding balls can be added without shutting down. Low power consumption.



COAL FIRING SYSTEM

Cutaway drawing of Kennedy Pulverized Coal Firing System showing disc feeder, pulverizer, classifier, exhauster and burners. Raw coal and pre-heated air up to 750°F enter one end of the pulverizer and leave at the other end. Moisture in the coal is liberated during pulverization.

MAXIMUM HEAT FROM PULVERIZED COAL...

Tremendous savings, *often exceeding $1.00 per ton,* are being realized by steam plants through the efficiency and unmatched economy of the KVS Pulverized Coal Firing System.

The KVS Coal Firing System obtains maximum heat value from every ton of coal burned. More heat means *more power* available from any given quantity of coal. No other system produces comparable results. By pulverizing coal to a fineness of 85% to 90% through a U.S. standard 200 mesh screen, maximum results are obtained.

With the KVS system, coal firing is instantaneous, combustion complete. Unburnt carbon losses held to less than ½% *at all ratings.* Pulverized fuel instantly available to meet fluctuating loads with quick, flexible response to combustion controls. Free moisture is liberated in the mill while the coal is being pulverized.

BURNS ANY GRADE OF COAL...CHEAPEST TO FINEST!

Because of the extremely fine pulverization with the KVS Coal Firing System, the cheapest grades of coal provide complete combustion comparable to that obtained from more costly fuel. Tramp iron not only cannot damage the mill, but actually helps pulverization!

To compare your present fuel costs with the results you can expect from a KVS Pulverized Coal Firing System, estimate your unburnt carbon losses . . . figure boiler efficiency at reduced rating . . . allow for coal loss when you change rating . . . include maintenance cost on equipment.

***Then,* remember:**

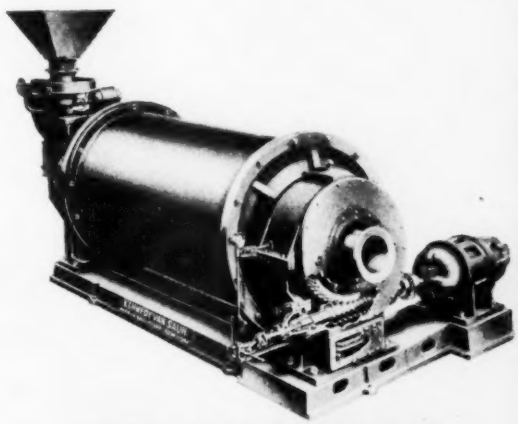
The KVS Coal Firing System obtains maximum heat value from every ton of coal burned.

or more on coal costs

pulverized coal firing system!

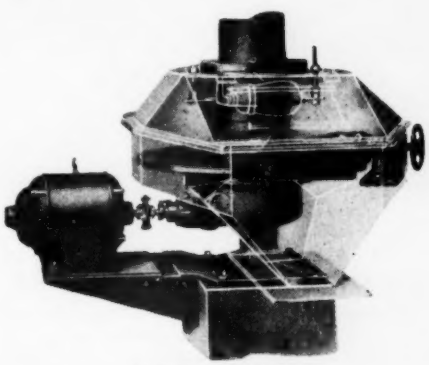
FEATURES OF KVS PULVERIZED COAL FIRING SYSTEM

- FULLY AIR SWEPT
- COAL PULVERIZED TO SUPERFINENESS
- COAL COMPLETELY CARBURETED . . . Ready for combustion
- BIG TRUNNIONS FOR AIR SWEEPING
- BALLS ADDED WITHOUT SHUTTING DOWN
- LOW OPERATING AND MAINTENANCE COSTS
- UNBURNT CARBON LOSSES LESS THAN ½%
- INSTANT RESPONSE TO CONTROLS
- 85% TO 90% THROUGH 200 MESH
- 20% MOISTURE REMOVED WHILE PULVERIZING
- PULVERIZES ANY COAL, BITUMINOUS, ANTHRACITE, COKE BREEZE
- TRAMP IRON ACTUALLY AIDS IN PULVERIZING
- RESERVES OF FUEL FOR INSTANT RESPONSE AND STEAM DEMAND



WORM GEAR DRIVEN MILL

Slow speed ball mill is desirable for medium and small mills up to 66 inches in diameter. Operates same as integral gear driven mill with high speed motor or turbine drive.



DISC FEEDER

Variable speed disc feeder is driven by an electric motor. It's completely enclosed to prevent coal dust from escaping into boiler room. Volumetric design prevents moisture content of coal from disturbing accuracy. Glass door and internal illumination permit easy visual inspection of moving coal. Disc cannot be broken by tramp iron or other foreign material.

GET THE FULL FACTS ON THE KVS COAL FIRING SYSTEM!

Write today for free bulletin describing this equipment.

IT COSTS LESS.. TO OWN THE BEST!

KENNEDY-VAN SAUN
MANUFACTURING & ENGINEERING CORPORATION
TWO PARK AVENUE, NEW YORK
FACTORY DANVILLE, PA.

Close Inspection

This cat picture makes us think of the final inspection of Midwest Welding Fittings. It is equally intense, searching, eye-on-the-ball type. Such final inspection is only one of an exhaustive series of continuous controls and checks that play an important part in assuring the high quality and uniformity of all Midwest Welding Fittings. You can cut your welded piping costs by specifying Midwest Welding Fittings.

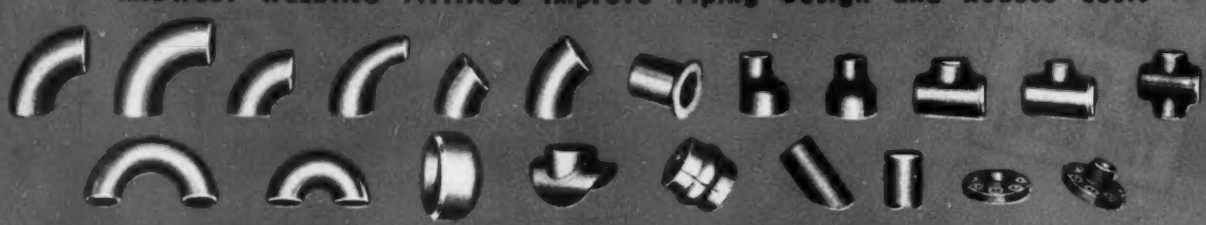
A corner of the Final Inspection Department where every Midwest fitting is individually checked for concentricity, uniformity, and dimensional accuracy. Such checks are the last of a series conducted during production.

MIDWEST PIPING COMPANY, INC.
Main Office: 1450 South Second Street, St. Louis 4, Mo.
Plants: St. Louis, Passaic, Los Angeles and Boston
Sales Offices: New York 7—50 Church St. • Chicago 3—79 West Monroe St.
Los Angeles 33—520 Anderson St. • Houston 2—1213 Capitol Ave.
Tulsa 3—224 Wright Bldg. • Boston 27—426 First St.
STOCKING DISTRIBUTORS IN PRINCIPAL CITIES

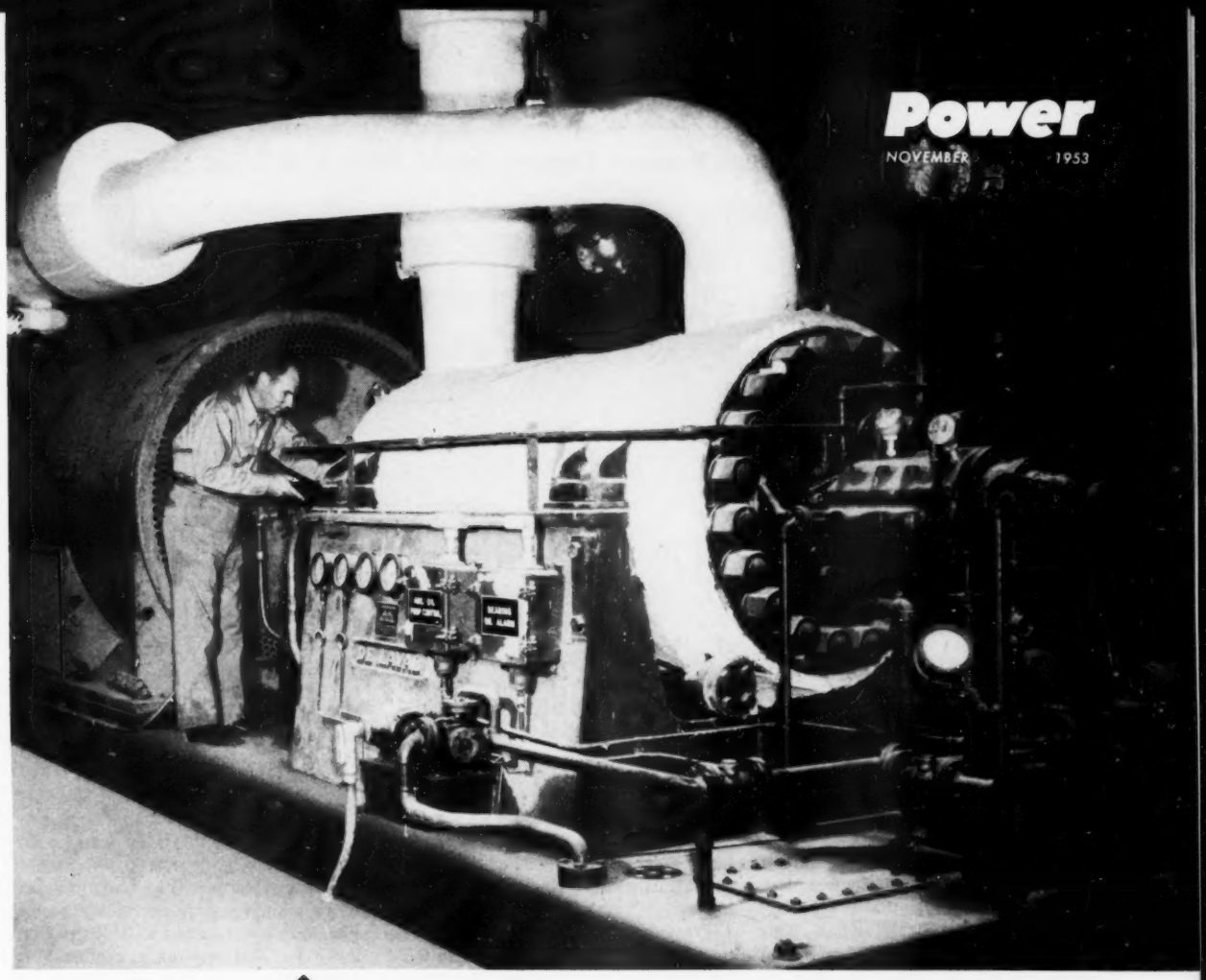
MIDWEST WELDING FITTINGS

6104

MIDWEST WELDING FITTINGS Improve Piping Design and Reduce Costs



Power
NOVEMBER 1953



BARREL-TYPE FEED PUMP, 1570 gpm at 2100 psi: starting point for engineers in . . .

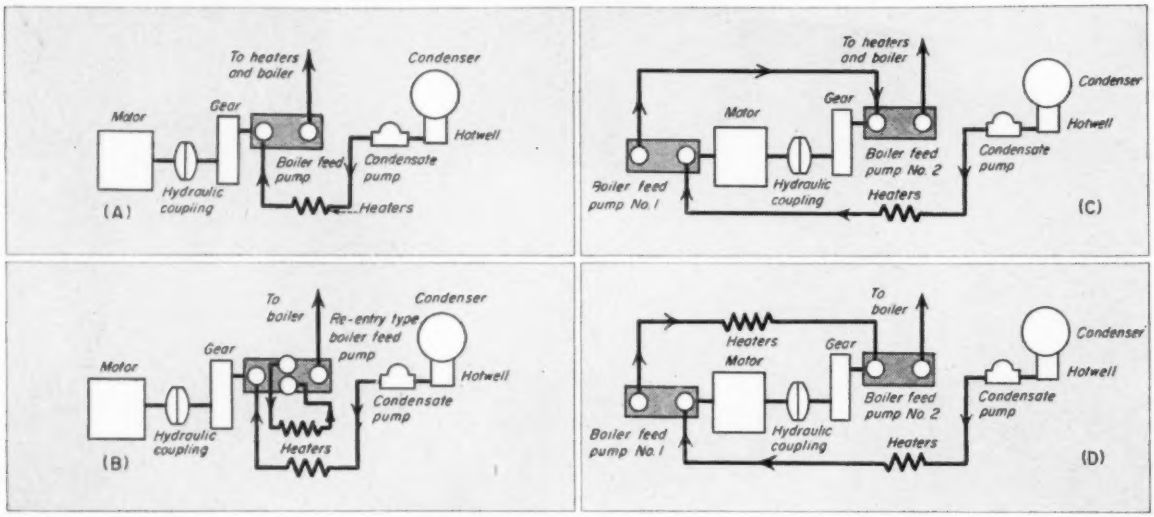
Feeding boilers that operate above critical pressure raises many pumping problems. These inside facts show how they are being studied, and the results expected

By **HANS GARTMANN**, *Chief Engineer*
Centrifugal Pump & Compressor Dept, De Laval Steam Turbine Co

Designing Superpressure Feed Pumps

TURN PAGE

Design of Pumps for High Pressures Requires Careful Study of Different Schemes

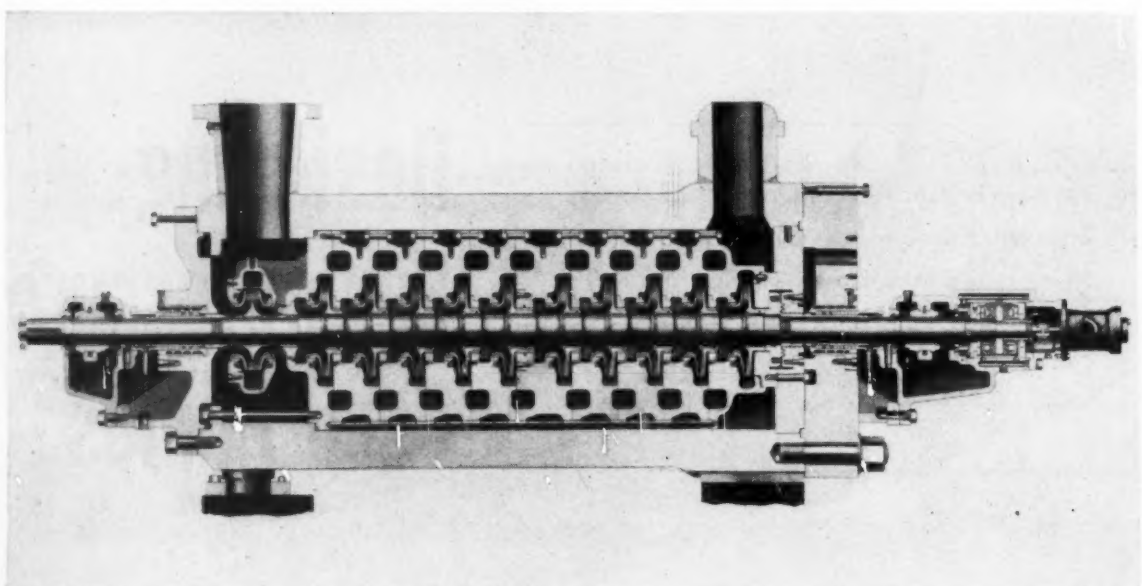


1 Four schemes studied for the application of special-type feed pumps to boilers operating above the critical pressure of steam. Single-casing arrangements *A* and *B* proved unsuitable. Using two casings, *C* and *D*, is more conservative

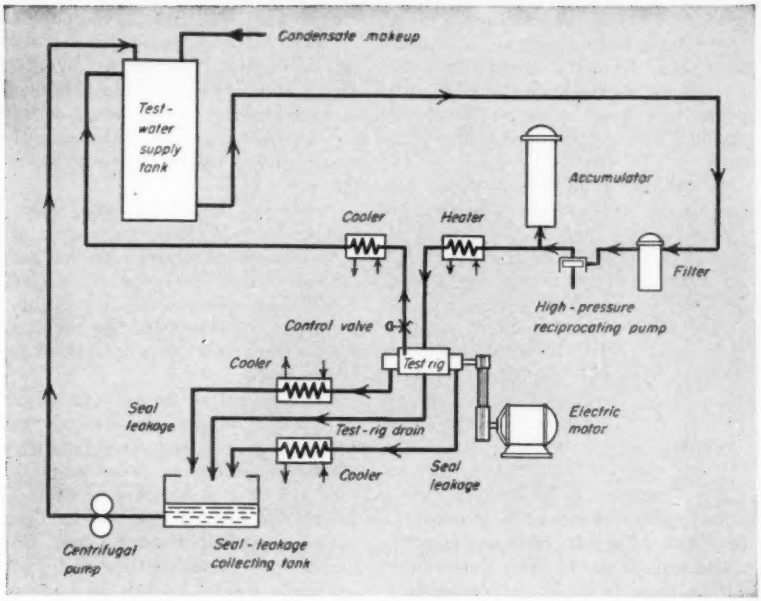
► As reported in July Power, p 150, and Sept, pp 80-85, we're at the start of a great stride forward in power-plant design—a move into the region far above the critical pressure of steam. This necessitates development of boiler-feed pumps having discharge pressures of 5000 psi or more. Superpressures are today's answer to the need for higher over-all thermal efficiency in large plants.

Present Practice. Today's central stations need boiler feed pumps suitable for maximum pressures in the 2600-psi range. A few of the latest stations use pumps discharging at 2800 psi.

In many plants it is standard practice to use a single-casing barrel-type pump, Fig. 3, below, running at 3550 rpm for this job. This type of unit must have as many as 12 or 13 stages. For a dis-



3 Cross section through a typical modern barrel-type feed pump designed for high-temperature high-pressure service. The pump consists of a single-suction radially-split diaphragm-type multistage pumping unit running in the forged-steel barrel



2 Seal test arrangement developed to insure adequate investigation of conditions at the seal during actual operation of the pump at pressures above the critical

charge pressure of 5000 psi, or more, about twice this number of stages would be required if pump ran at the same speed, 3550 rpm. This presents a most difficult design problem and requires a new approach.

Our firm has done much work on this problem, investigating several possibilities. It appeared evident from the start that for the high pressures involved, speeds higher than 3600 rpm must be considered to reduce the number of stages needed in the pump.

First Study. We started with a single-casing design running at 6500 rpm. Capacity selected was about 1000 gpm of 350-F water. Using a double-suction first-stage impeller, we chose a 9-stage pump. Our calculations show it should be possible to obtain reasonably good efficiency with this pump by driving it through a hydraulic coupling and gear, Fig. 1A. Specific speed of unit will be in line with that of other successful installations.

Further studies of this arrangement show that application of the feed system's high-pressure components (such as heaters) make it impractical for economic and design reasons. It is not now feasible to place high-pressure heaters between pump discharge and boiler.

Second Study. Next approach, Fig. 1B, used a similar pump, but it was fitted with re-entry features. First half of the unit would deliver to the heaters at 2500 psi the relatively cold water coming from the deaerator. After passage through the heaters, the water would return to the pump at about 500 F. Second half of pump would discharge the water at the rated design pressure.

Because half of the pump must handle water with a specific gravity of 0.786 as against a gravity of 0.892 for 350-F water, the horsepower of the second half of the pump will be increased about 13%, assuming the efficiency of both halves is about the same.

Studies of the design and economics of arrangement 1A and 1B show a more conservative hookup is preferable.

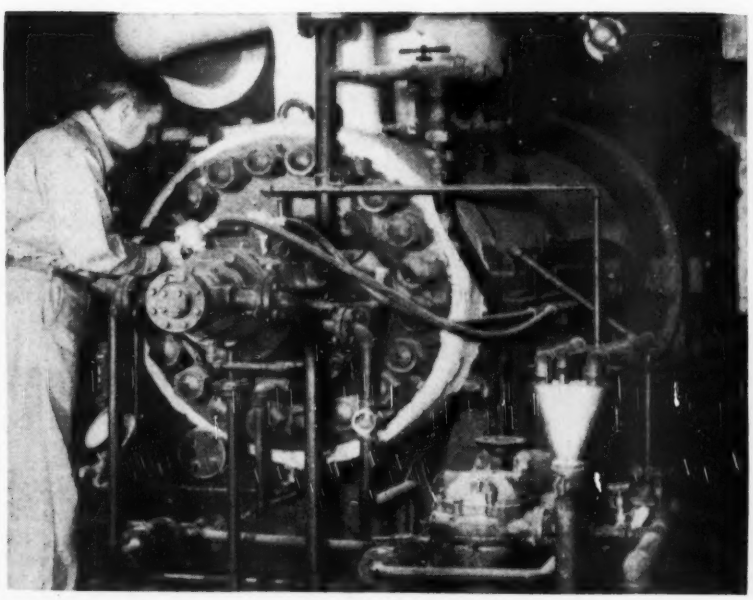
Third Study. Arrangement worked out resembles the setup that some utilities are now using. One pump feeds the heaters, its discharge going to a second unit after passage through heaters. Second pump discharges to boiler, Fig. 1D.

In effect, this design splits the pump into two casings, the first consisting of a standard up-to-date barrel-type feed pump, designed for a dischage pressure of about 2100 psi and operating at 3550 rpm. Second pump handles the remainder of the work in eight stages, turns at 6500 rpm.

Both pumps can be driven from the same motor, the discharge pump being driven through a variable-speed hydraulic coupling and a speed-increasing gear. Second pump handles 500-F water if hooked up as in 1D. With hookup 1C, second pump handles 350-F water but heaters are uneconomical, as in 1A.

Two-casing arrangement has some additional operational advantages. Hydraulic coupling size is smaller and its full-speed loss is less than for the arrangements in Fig. 1A and 1B. Part of this advantage is retained when the discharge pump runs at reduced speed.

It is interesting to note here that



4 End view of a barrel-type feed pump in a large utility station. The piping and service connections to high-temperature high-pressure units are important

heater costs are reflected in the type of pumping scheme chosen. This is necessary because excessive heater costs would reduce some of the savings that result from using superpressures.

DESIGN PROBLEMS

Performance. Feed pumps for superpressure plants require considerably more input horsepower per pound of steam delivered to main turbine than is required at lower pressures. It is, therefore, imperative that optimum pump efficiency be obtained in order not to jeopardize the advantages of the superpressure cycle.

Design of the high-speed pump for the various arrangements in Fig. 1A-1D requires new approaches to determine performance of the individual impellers and the correct shape of the discharge volutes. Tip speed is about 50% greater than that ordinarily used in modern pump practice. Our firm is developing basic design information by tests that check the performance of a complete stage operating at high tip speeds. Test rig is arranged to handle hot water so actual field inlet conditions can be obtained and the necessary net positive suction head for various capacities measured.

Compressibility. Some interesting problems present themselves when we make performance calculations for high-pressure pumps. We ordinarily think of water as being incompressible at the pressures encountered in usual boiler feed-pump practice. Actually, of course, water is compressible, and for pressures of 5000 psi this is definitely a factor to be considered.

Fig. 6A shows the rectangular pressure-volume diagram for an incompressible fluid. Diagram area indicates the amount of work in foot-pounds per pound that must be done to compress the fluid from suction to discharge pressure.

If the real properties of water are considered, the pressure-volume diagram changes to the shape in Fig. 6B. This shows that the theoretical work required is reduced somewhat by the volume change, V_1 to V_2. To illustrate the magnitude of the compressibility, assume that water at 500 F is compressed from 2000 to 5000 psi. Under these conditions the specific volume will be reduced 1.7%, assuming isentropic compression.

Because work is done on the water between points 1 and 2, Fig. 6B, the water temperature increases, even though pump efficiency is assumed to be 100%. For the 3000-psi pressure rise discussed above, water temperature will increase 10 F. Actual temperature rise will be still greater, depending on the internal losses in the pump. It is evident that it is necessary to consider compressibility during design of these pumps.

Shaft seal will be an extremely important part of a successful installation of a superpressure pump. Ordinary watercooled packing, as used in many present designs, will not be suitable for the pressures and speeds involved. This is particularly true of the secondary unit in Fig. 1C and 1D, where seal is exposed to 2100 psi and either 350- or 500-F water.

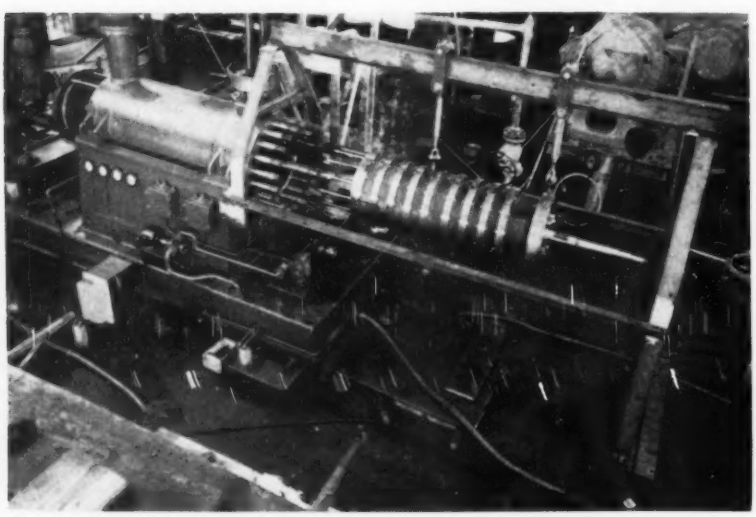
Design of the pump incorporates a packingless shaft seal. While this will require some leakage from the pump, a design is being developed that will keep this leakage to a minimum. Work is progressing on a test rig, Fig. 2, to check seal performance under actual operating conditions and to investigate the best materials combination suitable for the seal.

Materials. Research studies over a number of years have developed the proper chemical analysis of materials for feed pumps. Temperatures involved in superpressure applications are within the range of previous practice, requiring the use of chrome steels throughout the pump interior.

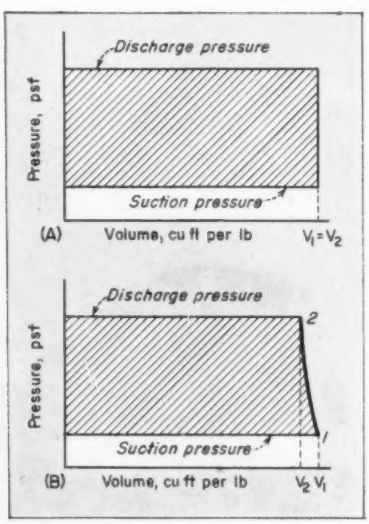
Physical-analysis studies indicate that wall thickness and stresses are well within safe limits and present no manufacturing problems. Some particular care will have to be taken to assure a good joint at the flange of the outer barrel of the high-pressure pump. Preliminary investigations show that a satisfactorily tight joint can be obtained with bolted construction, thus retaining ease of maintenance.

Our design includes provisions for bringing the inside and outside of the barrel up to operating temperature as uniformly as possible. Also, thermal expansion is provided for to minimize thermal stresses. Particular care must be given to expansion problems in high-pressure pumps for superpressure service.

Maintenance. Reliability is of prime importance in superpressure plants. The barrel-type feed pump has proven itself to be well suited for this service. Maintenance, when needed, is simple, can be performed quickly, Fig. 5.



5 Barrel-type feed pumps require little maintenance, but when work must be done on a unit it is important that disassembly be easy. "A"' frame here is big help



6 Pressure-volume diagrams for *A*, an incompressible fluid; *B* compressible

MUNICIPAL power-plant building has expanded twice to provide space for more capacity

Grand Haven Thrives With More Diesels

Installing slow-speed heavy-fuel-oil diesels successively is keeping this Michigan municipal plant out front in today's lively operating competition

By **J BRYAN SIMS**, *Superintendent, Board of Public Works, Grand Haven, Mich.*

► FROM THE INCEPTION of the municipal diesel power plant in 1931, we have consistently used large slow-speed diesel engines, burning straight-run residual fuel. This policy has paid off in fuel economy, low operating and maintenance costs.

In 23 years, plant capacity has grown from 1600 to 16,430 kw, keeping pace with load growth of the community. Grand Haven, which now has a population of 10,000 to 12,000, supports 51 industries that make a wide range of products.

Like many other municipal plants, we began with reciprocating steam engines, added turbines, and later turned to internal-combustion engines as a more efficient source of power.

Diesel Installations. The first two diesels installed in 1931 were DeLaVergne 4-cycle 200-rpm 1140-bhp 800-kw 6-cyl units. A similar unit was installed in 1934. In 1937, when the plant was expanded for two additional engines, a Nordberg 2250-bhp 225-rpm mechanical-injection 1600-kw 2-cycle 6-cyl unit was put on the line. In 1942, we added the fifth engine, a Nordberg 2-cycle 225-rpm air-injection diesel, rated at 3850 bhp, 2715 kw, 225 rpm.

In 1946, management, recognizing the need for additional power, studied the feasibility of extending and modernizing the 150-psi steam plant that had been retained for standby service. Coal could be purchased for $8 or $9 a ton. But the nature and size of the load was against economical steam operation, especially in view of the wide variance in load demand. Besides, operating both steam and diesel plants would have required additional personnel, since the steam plant is in a separate building.

So the diesel plant was extended a second time. The sixth engine to go on the line, another Nordberg 3850-bhp air-injection unit, started operation in June 1948. Total plant capacity rose to 9430 kw, but with peak loads zooming past the 7000-kw mark, the plant still did not have sufficient firm capacity.

The 1947-48 expansion had provided additional space for 4000 to 5000 kw in diesel power, or 5000 to 6000 kw in gas-turbine power. We took bids on both types of prime movers and made an investigation and analysis.

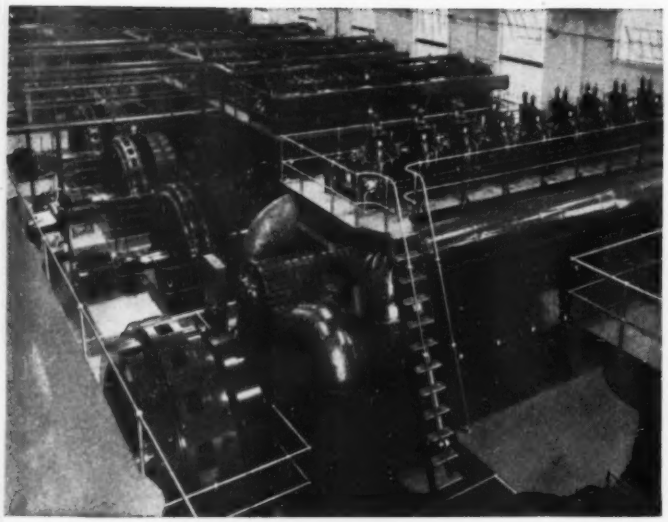
Advantages appeared for both types of prime movers. But over-all evidence indicated that the diesel engine was more advantageous for Grand Haven, and a 2-cycle, 9-cyl, 29x40-in. mechanical-injection diesel, rated 7000 bhp, 5000 kw net at 171.5 rpm, was ordered from Nordberg Manufacturing Co.

Before this unit could be built and installed, an anticipated power emergency required extra capacity at the earliest possible date. In addition, management wanted to save banking costs for fuel burned under the boiler in the steam plant. In June 1951, we installed two 1000-kw General Motors' surplus engines in the powerhouse basement. These engines operate at 720 rpm, burning a gas oil or No. 3 distillate. They supply standby and peaking power.

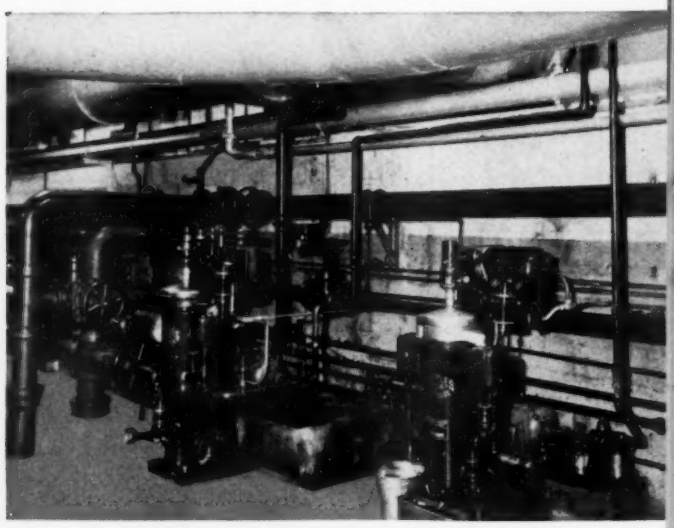
We also ordered a Nordberg 3000-kw 10-cyl 4300-bhp 225-rpm 21½x31-in. 2-cycle mechanical-injection unit, which will replace the No. 3 DeLaVergne engine when it is installed in late 1953.

The 5000-kw unit was placed in service April 11, 1952, giving the plant a total capacity of 16,430 kw. All the engines, except the two General Motors units, use residual oil for fuel.

Auxiliary Equipment. Table bottom of page 77 lists auxiliary equipment for the new 5000-kw engine. One of the interesting features of the installation



MAIN OPERATING FLOOR: seven diesel generating units that burn the residual fuel oil. Total plant capacity is 16,430 kw



FUEL-OIL centrifuges, on the lower operating floor, run in shifts so that two are working while the third unit is being cleaned

is the 500-hp 7200-v 3600-rpm scavenging-blower motor that is direct-connected to the generator and comes up to speed with it. Special means of excitation are necessary at the low starting speeds.

Maintenance Schedule. As an immediate benefit of the new installation, some of the older engines, which had been operating round the clock, could be relieved. Maintenance, which often had been limited to Sundays, was now worked out on a routine basis.

Fuel Economy. As a prime benefit, the new unit meant increased over-all plant economy. In the twelve months of 1952, the total plant turned out 37,879,830 kwhr, using 3,081,641 gallons of fuel oil. Over-all plant average was 12.29 kwhr per gallon of fuel.

The three DeLaVergne units generated 13,872,400 kwhr, using 1,197,433 gallons of fuel for an average of 11.58 kwhr per gallon. The Nordberg engines, excluding the 5000-kw unit, turned out 13,684,700 kwhr on 1,142,095 gallons for an average of 11.98 kwhr per gallon. Total average for the six older oil-burning engines was 11.77 kwhr per gallon.

On a dollars-and-cents basis, these figures show the economies made possible by burning heavy fuel. Grand Haven currently pays a delivered price of 7c a gallon for residual fuel oil. Based on 1952 records, the heavy-fuel-oil engines, except the new 5000-kw unit, generated 27,557,100 kwhr, consuming 2,339,528 gallons. With fuel costing $163,766.96, the average cost per kwhr was 5.94 mills. The 5000-kw unit generated 9,539,300 kwhr, burning 673,427 gallons, costing $48,139.89. Cost per kwhr is 5.04 mills, which is 0.90 mills per kwhr below the average fuel cost of the smaller units.

Space Economy. Not only has modern diesel power brought excellent fuel economy to Grand Haven, but it has also increased the amount of power installed in a given space. The new 7000-hp 5000-kw unit occupies the same relative bay space as the original 1140-hp units. But considerable ingenuity was needed to squeeze this large amount of power into the limited space available in the plant. Of course, once an engine of this size is installed successfully, there are many gains from the space saving obtained. So needed initial planning is worthwhile.

Type of Fuel. For the large engines at Grand Haven, fuel is purchased in quantity lots and delivered by truck from a refinery at nearby Muskegon, Mich. It is classified as a No. 5 or 6 straight-run residual fuel oil of both asphaltic and paraffinic bases. Classification varies with market conditions. It ranges from 16 to 23 API with a viscosity of 500-1000 at 100 F. Pour point averages 60 F, Conradson carbon 3 to 5%, sulfur 0.75 to 1.5%. Original source of the crude oil may be Michigan, Oklahoma or Texas. As delivered to the Grand Haven power plant, fuel is the straight-run residual from the refinery's catalytic cracking process.

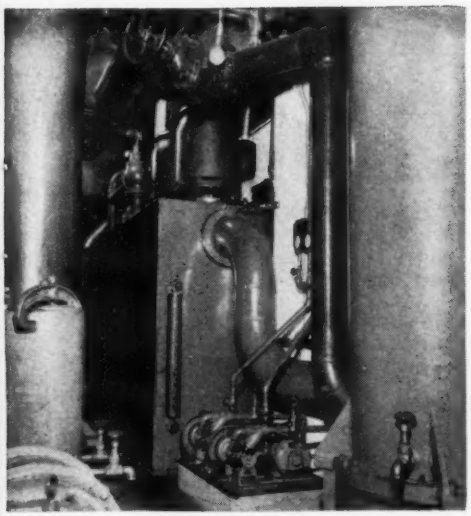
Fuel Storage. Residual fuel oil is stored in four tanks with a total capacity of 1,090,000 gallons. Two 420,000-gallon tanks are aboveground, and two tanks of 150,000 and 100,000 gallons are underground. An additional 100,000-gallon-capacity tank stores the UGI gas oil or No. 3 distillate for the General Motors units.

All fuel piping is insulated, and soil-heating cables run parallel with piping to heat the oil in an emergency. The storage tanks, conical-bottom settling tanks and individual engine day tanks all incorporate copper heating coils, receiving steam supplied by waste-heat boilers.

Fuel Handling. Fuel oil from storage is pumped through a steam heater to one of three Sharples centrifuges (photo, above). Two of these units are always in operation while the third is being cleaned, and they generally run for an 8-hour period. Following centrifuging, fuel oil passes to one of six conical-bottom day tanks—two for the DeLaVergne units and four for the Nordberg engines. Heating coils around the inside of these tanks return the oil to 180 F. and it is then pumped to the individual engine tanks. Here again, heating coils maintain constant temperature. Next, oil is pumped through duplex filters to the engine injection pumps.

Foster-Wheeler waste-heat boilers, installed on the two 3850-bhp and the new 7000-bhp units, provide heat for the heavy-fuel-oil system as well as for plant heating. Exhaust gas from these units passes directly through the boilers and then vents outside through large exhaust mufflers. Boilers are designed for 150 psi, usually operate at 40 psi. Steam is piped to the steam-plant feedwater heaters, or vented to atmosphere when there is more than required.

Maintenance cost is important in evaluating over-all operation and de-



LUBE-OIL pumps for the three original engines are now in the engine sump tank

termining production costs. Because of its use of heavy fuel, maintenance costs at Grand Haven are interesting.

On the basis of operating records for the 1951-52 fiscal year (see top table) 37,056,994 kwhr were generated. Total production expense, including superintendence and labor, fuel, water, production supplies and lubricants, repairs and station expense, was $343,286.12, or 9.26 mills per kwhr. Of this total, maintenance amounted to $30,793.19, or 0.82 mills per kwhr. Fuel cost of $248,184.11 represents an average of 6.6 mills per kwhr. Total maintenance amounts to only 12% of the fuel cost.

Rates available to Grand Haven customers are shown in second table. There are now 142 industrial light and power accounts, 746 commercial and 4197 residential. Grand Haven station serves customers within a radius of 6 or 8 miles and has a substantial demand from the outlying residential and rural areas.

The plant has to operate on an economical basis to offer favorable rates in the highly industrialized area it serves. The city is on the east shore of Lake Michigan in the center of one of the state's principal industrial areas. Local demands on the power plant continue to increase, with the peak at 11 am now over 9000 kw.

Operating personnel consist of an operator and an oiler per shift with a chief operator in charge of the day shift. A combination maintenance and construction crew varies in size with the amout of construction in progress. The system's own organization has done all engineering required for the planning and installation of the new units.

Operating Statement—Power and Light Department

Fiscal year July 1, 1951 to June 30, 1952

		1952	1951
Power generation			
Kilowatt-hours generated		37,056,994	35,566,960
Station kilowatt-hours used		1,450,700	1,428,500
Kwhr available for sale		35,606,294	34,138,460
Kwhr sold		32,380,946	30,889,831
Line loss on kwhr		3,225,348	3,248,629
Line loss, %		8.70	9.13
Production expense			
Power-plant superintendence		$ 9,363.42	$ 8,217.13
Engine labor		28,305.28	28,025.22
Miscellaneous labor		11,737.51	15,248.30
	Total	$49,406.21	$51,490.65
Power-plant supplies and expenses			
Fuel		$ 248,184.11	$ 232,923.53
Water		734.56	502.96
Production supplies and lubricants		10,497.52	7,926.12
Repairs—tools and equipment		290.76	397.72
Station expense		3,379.77	3,551.47
	Total	$263,086.72	$245,301.80
Power-plant maintenance			
Station—buildings and grounds		$ 2,705.86	$ 624.59
Electrical equipment		996.32	1,232.45
Piping and accessories		160.48	57.73
Engines		24,008.47	27,941.74
Oil purifiers		630.77	521.99
Hydroil and accessories		1,454.51	392.81
Water pumps and accessories		118.84	272.62
Fuel-oil tanks		—	501.34
Miscellaneous		717.94	768.13
	Total	$30,793.19	$32,313.40

Residential, Commercial and Industrial Rates

Residential	4.9¢ per kwhr first 15 kwhr 3.9¢ per kwhr next 35 kwhr 2.2¢ per kwhr next 150 kwhr 1.6¢ for remainder
Commercial	4.8¢ per kwhr first 30 kwhr use of active load 3.4¢ per kwhr next 100 kwhr 1.8¢ per kwhr next 100 kwhr 1.7 ¢ for remainder
Industrial (over 50 kw)	90¢ per month per kw demand 2.1¢ per kwhr for first 60 hr use of demand 1.7¢ per kwhr for next 60 hr 1.2¢ per kwhr for next 60 hr 0.8¢ for remainder

Auxiliary Equipment—5000-Kw Engine

Generator, 5500 kw, 7200 v, 3 ph, 60 cycle	General Electric Co
Exciter, 40 kw, 125 v, 850 rpm	General Electric Co
Silencers, exhaust and intake	Maxim Silencer Co
Lube-oil cooler	Kewanee-Ross Corp, Ross Heater Div
Jacket-water cooler	Kewanee-Ross Corp, Ross Heater Div
Blower and 500-hp motor	Elliott Co
Lube-oil pumps, main and auxiliary	De Laval Steam Turbine Co
Jacket-water pumps	Allis-Chalmers Mfg Co
Waste-heat boiler	Foster Wheeler Corp
Oil-purifier pumps	Haight Co
Duplex filter	W W Nugent & Co
Gage board	Nordberg Mfg Co
Alarm system	Viking Alarm Co
Exhaust pyrometer	Alnor (Illinois Testing Labs, Inc)
Flexible connector	Zallea Bros
Starting-air tanks	Milwaukee Reliance Boiler Works
Blower expansion joint	United States Rubber Co
Lube-oil filters	Honan-Crane Corp

How to Pick the Right Pipe Insulation

Choosing the most economical thickness for insulation used on hot pipes is laborious if you use only a slide rule and the standard mathematical relations. Here are two charts and a calculation method that simplify and speed insulation choice

By P J M DE LEIJ
Department of Energy Supply, State Mines in the Netherlands

► THICKNESS CHOSEN for hot-pipe insulation depends on the purpose of the covering. This may be (1) preventing burns (2) reducing air temperature in rooms through which the pipe passes, or (3) reducing heat loss from the pipe.

Safety. Only consideration here is the surface temperature of the insulation. Thickness chosen is that which gives a safe surface temperature, regardless of the amount of heat lost to surrounding air. The same is more or less true when the pipe is insulated to prevent high room-air temperatures.

Heat Loss. Reduction of heat loss is of greatest importance when fluid conveyed by pipe is used in power generation or for heating. Thickness may be computed by starting from (1) maximum permissible heat loss, or (2) this question: What thickness will give lowest total cost of insulation plus heat losses?

First basis is the customary one and needs no further explanation. Second is less popular because it is usually laborious. However, it yields the most economical insulation thickness—that at which capital charges plus cost of heat loss are a minimum.

Materials. Where you must choose between several insulations differing not only in price but also in heat conductivity, the problem is more complex because each has a thickness that is most economical for certain job conditions. What we must do is narrow down our choice to the best thickness and material for *this* particular application. Most economical thickness is that at which sum of capital and heat-loss costs is a minimum for the various materials considered.

In this article we assume in every case the material under consideration has suitable physical properties for the job.

Computations. Though straight arithmetical determination of the most economical thickness is possible, the time and effort involved are too great for ordinary design work. This article presents a calculation method and charts from which the best thickness and the most profitable insulation can be rapidly determined. Let's see how they are used.

Example: Find the most economical thickness of insulation for a 10-in. line conveying steam at 530 F if temperature of the surrounding air is 80 F; the value of heat \$0.25 per million Btu; annuity = 0.1232 (10-year life with interest at 4%); probable operating period = 10 months per year; heat-transfer coefficient, insulation to surrounding air = 1.5 Btu per sq ft hr F; conductivity, k, of the insulation at its mean operating temperature is 0.60 Btu per sq ft hr F in. Prices quoted for different thicknesses are as follows:

Insulation thickness, in.	*Cost, inc cover, \$ per running ft*
2	1.22
3	1.60
4	2.25
5	3.10

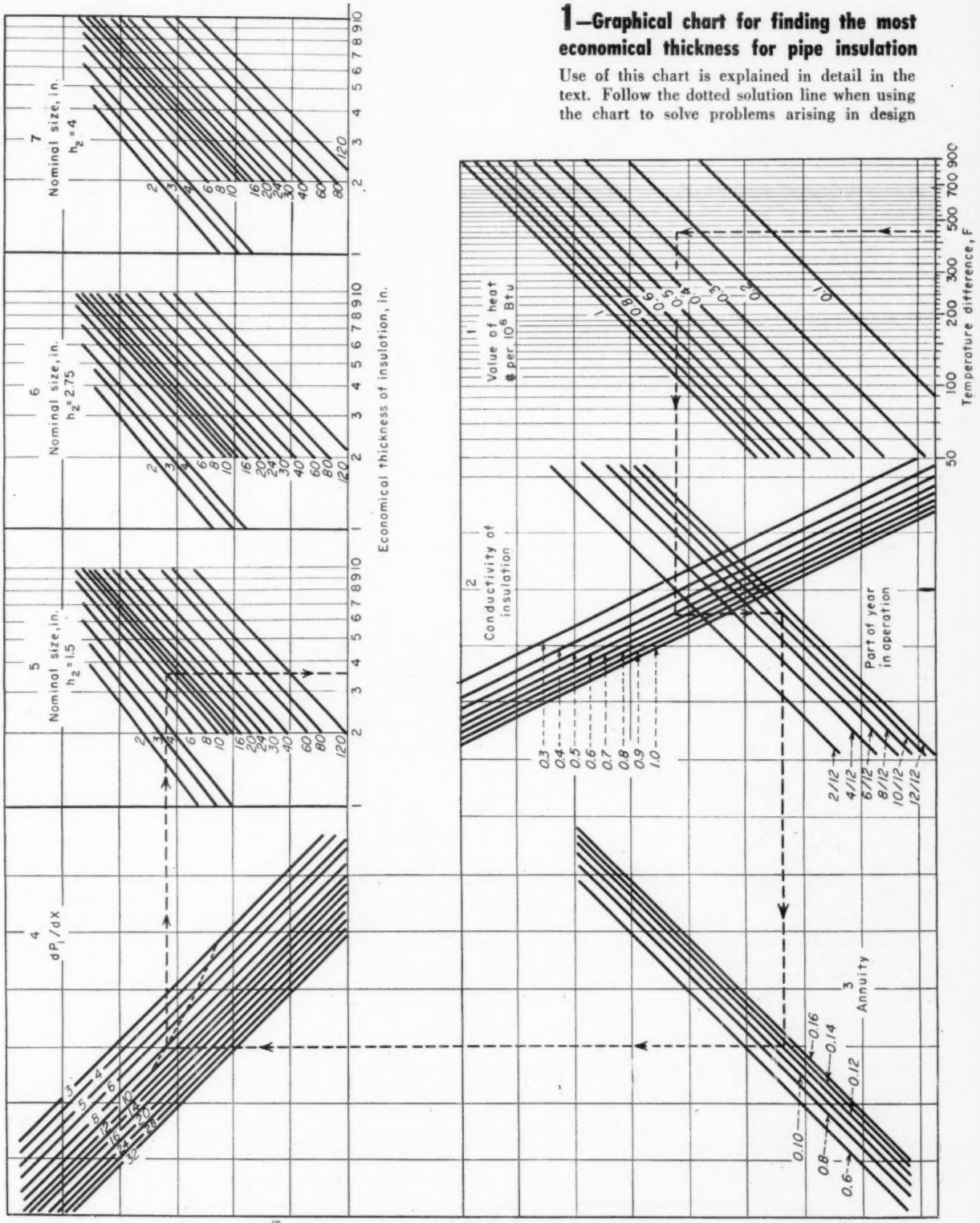
Solution: Temperature of the insulation's inner surface can be assumed equal to that of the steam, or 530 F. Air temperature is 80 F, so temperature difference is 530– 80 = 450 F.

Plot insulation price vs thickness as in top curve of Fig. 3, p 81. Using the scale in the middle of Fig. 3, or method given in editor's note at the end of this article, construct the dP_1/dX curve. (Be sure to read caption for Fig. 3 before performing this step.) Now draw the dP_1/dX curve in graph 4 of Fig. 1. Do this by finding four arbitrary values for dP_1/dX and erect perpendiculars on the horizontal axis of graph 5, (h_2 = 1.5) Fig. 1, at points corresponding to values of X chosen. Project these lines to intersect the D_1 = 10-in. curve on graph 5. From the four points of intersection, project horizontally to the left to corresponding dP_1/dX curves in graph 4. Through the four points thus found, draw the dP_1/dX curve.

Though construction of this last curve may appear to be time-consuming, it is a matter of only a few minutes once experience is gained with the method. We are now ready to determine the most economical thickness for the insulation.

Enter Fig. 1 at the bottom at a temperature difference of 450 F and project vertically to the value of heat, \$0.25 per million Btu. From this point project horizontally to the left to intersect the conductivity curve, then vertically to the operating-period curve, 10/12 year. Project horizontally to the left from this intersection to the annuity, 0.1232, then vertically to the dP_1/dX curve. Final step is to project horizontally to the right from this intersection to the D_1 = 10-in. curve on graph 5. At the bottom of graph 5 read the most economical thickness as 3.6 in.

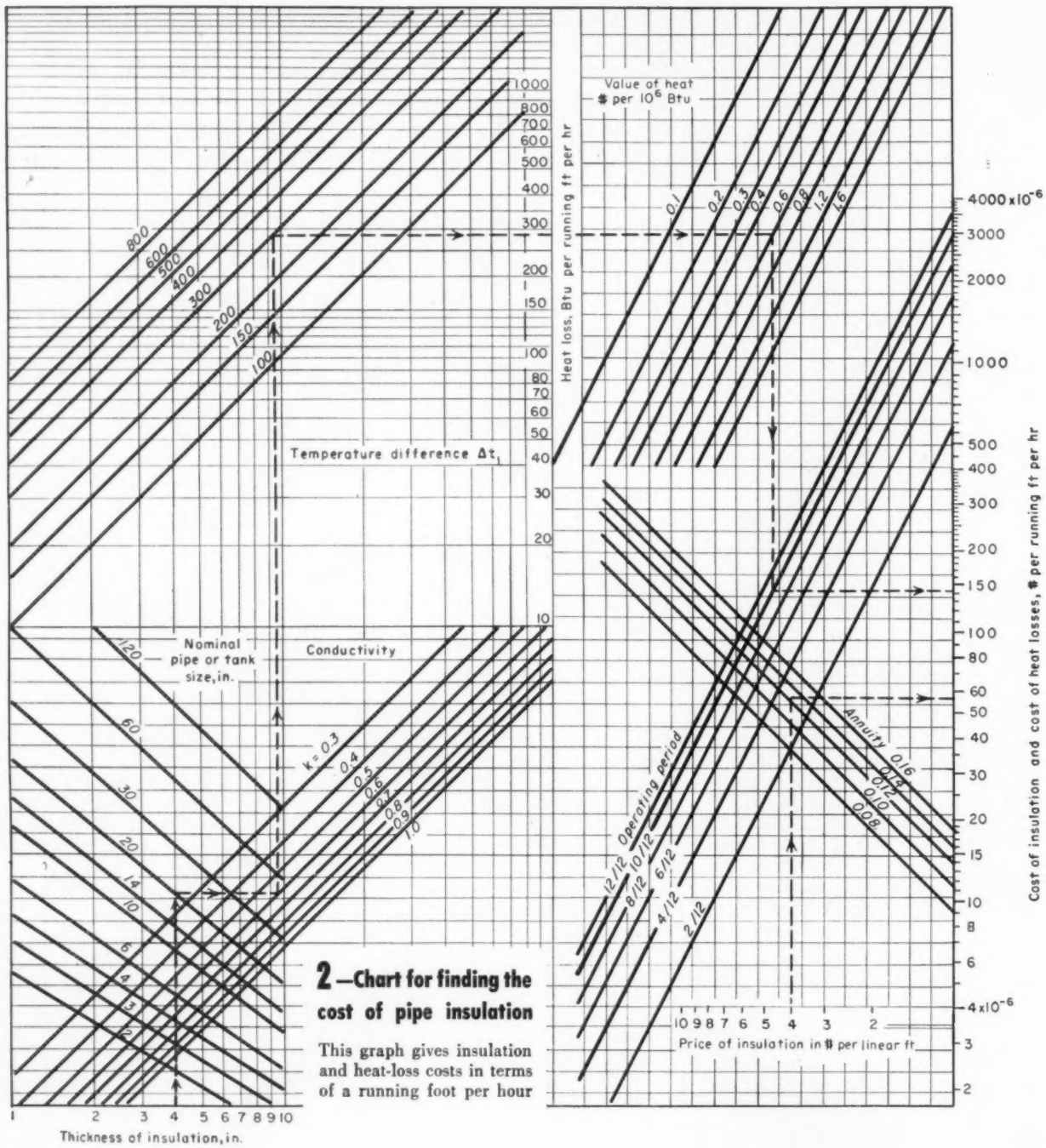
Best Insulation. Other factors being equal, the most economical insulation is that giving the most profitable return on the investment. When bids from a number of firms are obtained, careful analysis is needed to determine which construction and thickness is best. Here is an example of how



1—Graphical chart for finding the most economical thickness for pipe insulation

Use of this chart is explained in detail in the text. Follow the dotted solution line when using the chart to solve problems arising in design

More on next page


Value of heat
$ per 10^6 Btu
Heat loss, Btu per running ft per hr
Temperature difference Δt1
Nominal pipe or tank size, in.
Conductivity
k = 0.3
Operating period
Annuity
Price of insulation in $ per linear ft
Cost of insulation and cost of heat losses, $ per running ft per hr
Thickness of insulation, in.

2—Chart for finding the cost of pipe insulation

This graph gives insulation and heat-loss costs in terms of a running foot per hour

the most profitable insulation may be found quickly and easily.

Example: Four firms quote insulation prices for an 18-in. line conveying steam at 437 F. Find the most profitable choice if surrounding air temperature is 77 F; value of heat = $0.3 per million Btu; operating period = 8/12 year; annuity = 0.1232. Quoted prices are detailed at right:

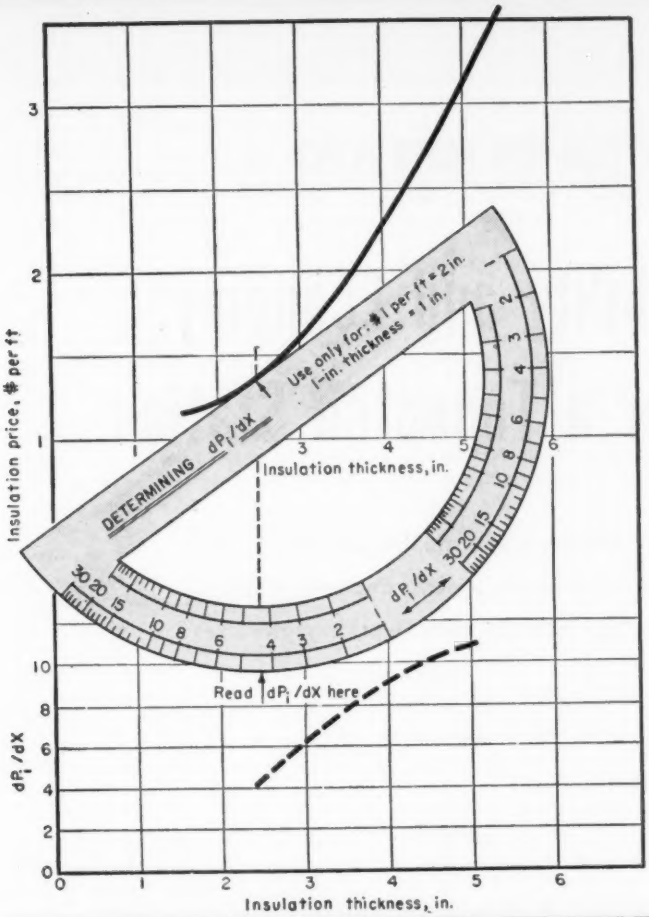
Solution: Plot quoted prices for each insulation, as in Fig. 4; then tabulate dP_1/dX values, most economical thickness, cost per running foot, and cost of heat losses and insulation. The

(*Continued on page* 220)

Quoted Insulation Prices From Four Firms

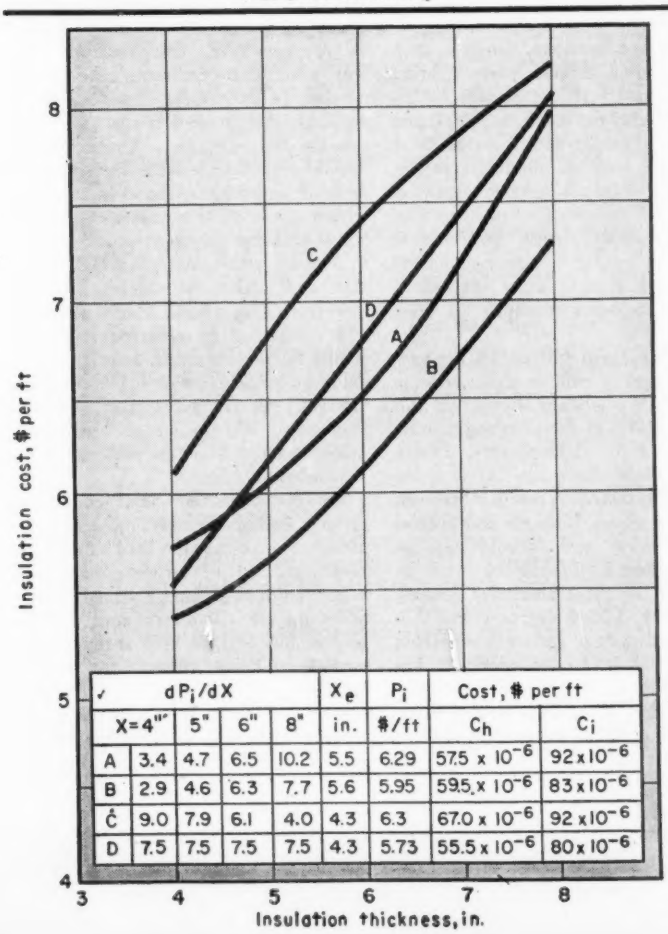
		$ per running ft, thickness of:				*k at*
Firm	*Construction type*	*4 in.*	*5 in.*	*6 in.*	*8 in.*	*390 F**
A	Shell, jute-wrapped	5.74	6.06	6.52	7.98	0.72
	Stuff-up with:					
B	Cement surface	5.36	5.68	6.13	7.31	0.79
C	Aluminum surface	6.09	6.83	7.43	8.22	0.72
D	Flint-coat surface	5.53	6.17	6.81	8.07	0.60

*Mean temperature of the insulation



3—You can construct the scale that's shown here to reduce work

To simplify plotting of the dP_i/dX curve, construct semicircular scale like the one shown here and paste it on stiff cardboard. The scale shown is exactly half size, so double all dimensions before constructing it. It is not necessary to draw the dP_i/dX curve (the lower one in this illustration) separately. It is easier to plot it immediately on graph 4 of Fig. 1, p 79. Find dP_i/dX values by laying scale tangent to price curve and reading as shown. Note that price curve must be laid out on scales set up so $1 per ft = 2 in., and 1-in. thickness of the insulation = 1 in. Before constructing this scale be sure to read the editor's note at end of article, on p 222. Graphical determination of the slope of a curve may prove difficult because there is such a wide variation in the angle at which the operator may judge the tangent to lie. Tabular differentiation is often preferred because more accurate results are obtained, no matter who does the work



✓	dPi/dX				Xe	Pi	Cost, $ per ft	
	X=4"	5"	6"	8"	in.	$/ft	Ch	Ci
A	3.4	4.7	6.5	10.2	5.5	6.29	57.5 x 10^{-6}	92 x 10^{-6}
B	2.9	4.6	6.3	7.7	5.6	5.95	59.5 x 10^{-6}	83 x 10^{-6}
C	9.0	7.9	6.1	4.0	4.3	6.3	67.0 x 10^{-6}	92 x 10^{-6}
D	7.5	7.5	7.5	7.5	4.3	5.73	55.5 x 10^{-6}	80 x 10^{-6}

4—Plot the cost of insulation as here when figuring the best type

When several types of insulation are offered for a job the problem of the most economical thickness becomes more complex. You must also select type of material and construction that are most profitable for the job. Plotting insulation cost as shown here and tabulating the most economical thickness, price per running foot, and cost of insulation and heat losses, per hour per foot, permits easy determination of which insulation gives the lowest total cost. Careful analysis is required because the most profitable insulation cannot be picked from this plot by simple observation. See the text for a complete discussion of how this plot is used in conjunction with the graphical charts, Fig. 1 and 2. Tabulation form can be copied for use in routine job calculations and for records showing why a particular type and thickness of insulation were chosen for the hot pipes then under consideration.

HOW TO ORGANIZE YOUR NEW POWER PLANT—4

Safety, Reliability and Economy: Watchwords for a Topnotch Station

Given the equipment and operators you must make them work together with maximum effectiveness. Success depends on starting with the right design, developing good working attitudes

By D C SWIFT, *Ebasco Services Incorporated*

► A POWER PLANT is rather dangerous because there is always the possibility of explosion, fire, electric shock, falls, cuts, bruises and burns from contact with machinery.

Safety. Special efforts make the power plant a safer place to work. It usually has devices, such as safety valves for boilers and pressure vessels, overspeed trips, fuel cutoff protection against hazardous combustion conditions, fuses and circuit breakers to prevent electrical failure. All these must be kept in first-class condition. They should be tested at intervals to check their reliability.

Elevators, stairs, guards, floors must be kept in good repair. Protective screens are a must to prevent contact with moving machinery. Heat insulation has to be kept in place where surfaces may burn a man. Using special clothing and shoes may be advisable in some areas. Pressure vessels and pipelines should not carry excessive pressures.

Floors, beams and hoists must be kept in good condition and not overloaded. Guards and covers prevent contact with, and incorrect operation of, electrical switches and devices. Steps should be taken to prevent explosive dust-air mixtures about coal handling equipment or hydrogen-air mixtures about generators. Suitable fire-fighting equipment must be available throughout the plant. Use special precautions and equipment in handling acids, alkalis, chlorine and other dangerous chemicals.

A regular program for promoting safety in the power plant should be followed. Safety meetings, contests, accident-prevention drives, posters bring safety constantly to the employees' attention. Money for meals, supplies, and employees' time at safety meetings is usually well spent in promoting safety. First-aid facilities and arrangements for handling serious accidents must be provided. Accidents should be reported promptly to proper company and civic authorities. Employees must be required to report accidents promptly to their foreman.

A consistent and fair policy for payment of wages or compensation benefits for lost-time accidents should be followed. Features of the plan ought to be made known to all employees. Safety goggles, safety shoes, special clothing and tools for hazardous mechanical work and rubber gloves, blankets and special electrical safety tools should be supplied as needed. Employees must be required to use these protective devices.

Reliability. A high degree of reliability and continuity of service is desirable since electric loads are generally important. Monetary loss and inconvenience may be caused by a service interruption, particularly by one that has not been scheduled.

Thoroughly trained, careful operators are probably the most important basis of reliable operation. They (1) avoid placing undue stresses, strains and overloads on equipment, (2) see that plant is properly run, (3) promptly note any abnormal condition, have it corrected, (4) regularly check safety devices, (5) keep cool heads in time of trouble or emergency. Observance of safety precautions have an important bearing on reliability because avoidance of accidents often means avoidance of unscheduled equipment outages.

A clean well-lighted plant aids operation and makes symptoms of trouble more apparent. A leak, an unusual noise, a vibration or temperature rise often points to trouble and these can be spotted more quickly in a clean, bright plant. Correct, regular lubrication, periodic inspection of equipment, preventive maintenance all aid in preventing unscheduled outages.

Reserve Equipment. For continuous service enough generating units are usually run so that the load can be carried with loss of largest single unit. Where equipment can be placed in operation quickly, the reserve unit may not be run but will be held ready for immediate starting. Storage tanks, bins, batteries and reservoirs often provide a reserve which may be drawn upon until other equipment can be brought into service. Boilers can be kept on hot bank

in case of sudden load increase or loss of an operating boiler.

Important automatic control devices should be arranged to lock in position in event of loss of the operating medium. Alarms to warn of excessive temperatures, abnormal levels, or over or under pressure should be installed to prevent damage and outage. Periodic tests of alarms and automatic equipment should be made so that dependence on these devices may be justified.

Anticipating Trouble. Operators must understand the relationship of the different parts of their plants. Steps to be taken in case of various troubles should be planned in advance. Load changes should be anticipated and equipment prepared for the new condition.

If generators should become overloaded so as to cause a frequency drop of 1 to 2%, electrically-driven auxiliaries may lose capacity and cause further reduction in plant capacity. Set up a schedule of loads to be dropped in event frequency falls below safe limits. Shed load until frequency rises to minimum value that develops the full plant capacity.

Sometimes total electrical load is reduced by dropping voltage instead of dropping certain individual loads. This, however, causes motors carrying fixed loads to draw more current and may cause burnouts or tripping of over-current relays. A similar increase in current may occur in the generator if a constant kw load is carried at reduced voltage.

Losses of units and plants have resulted from transferring station auxiliary supply from generator to bus and then taking the generator off the line, completely overlooking the fact that the generator was the only source of supply to the bus. Unless trouble is definitely known to be on a particular unit, it is better to leave the auxiliaries on their own generator, dumping load if necessary to hold frequency and voltage.

Similarly, it is inadvisable to pull steam pressure down more than 5 or 10% below normal in trying to hold load. This reduces steam-driven auxiliary capacity and correspondingly the station capacity. Steam-jet air pumps may allow air to flow back into the condenser if steam pressure falls below the critical or "break" point. This may cause the turbine to trip out because of low vacuum.

It is advisable to set up instructions for load shedding to prevent heavy drops in steam pressure. Most of the load may be held and since auxiliaries stay in operation, service may be restored quickly. By not doing this, a unit may be completely lost with necessity for complete restarting of auxiliaries and the entire generating unit. Temperature strains from sudden drops in steam temperature and pressure are minimized by keeping steam conditions up and reducing steam output as necessary.

Economy. While plant design primarily controls plant economy, operating and maintenance practices also have considerable effect. Efforts to reduce production costs to a minimum consistent with safety and reliability are well worth while and are a part of each operator's job.

Usually, more money can be saved in fuel consumption than in operating labor and maintenance. The first need is a fuel giving the lowest overall cost, including maintenance, without affecting plant reliability or capacity. Next comes handling and storing of fuel without waste. Then the fuel must be burned as efficiently as possible. This involves controlling excess air, pulverization, properly adjusted burners and stokers, clean heat-transfer surfaces in furnace, boiler, superheater, economizer and air preheater.

The steam generated must be used to produce maximum power. Steam conditions must conform to design limitations of boiler and turbine. Condition of the turbine largely determines efficiency of power generation. Condenser conditions and cooling water temperature play an important part in plant efficiency. Feedwater heaters must be kept clean and well vented. Pumps and fans should be adjusted to match the plant load for top plant performance.

Load allocation among parallel units may have an important effect on overall station efficiency. Units should be put on the line as needed to carry load and provide reserve capacity. The load should be distributed so that the unit with lowest incremental cost at each load level picks up the next increment of load. Unit incremental heat rates must be determined from input-output tests or design data.

Operating labor economy may be achieved by using no more men than needed to run the plant safely and reliably. Convenience of control and instruments, number of log sheet readings, use of labor-saving devices have a bearing on this. Type and kind of fuel may also have considerable effect. Least number of men needed is usually fixed by the time required to get the plant back in service after an emergency outage.

Maintenance costs depend on type of equipment, load and fuel characteristics, operating and repair methods. Preventive maintenance catches troubles in their early stages, eliminating serious breakdowns and consequent overtime work costs. Scheduling maintenance work should consider effect of replacing output loss with production from higher-cost source. All tools and parts should be available before starting a repair job to reduce outage time of main equipment.

Miscellaneous costs for water treatment, lubricants, office supplies, etc, should be watched even though they are not large. Careless practices will develop over the years unless periodic reviews are made.

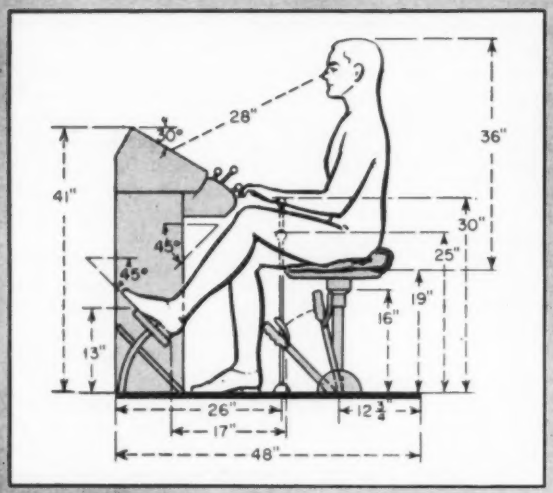
Cleanliness. As a rule, a clean power plant is well run. A plant starting out clean and shiny can be kept that way by an adequate cleaning program. Plant men will take pride in their work, clothing and lockers will stay cleaner, and it will be a happier plant. Operators will be able to see leaks quickly and they will not hesitate about getting into a dirty corner to look at a piece of equipment. Less dirt will be carried into bearings during routine lubrication.

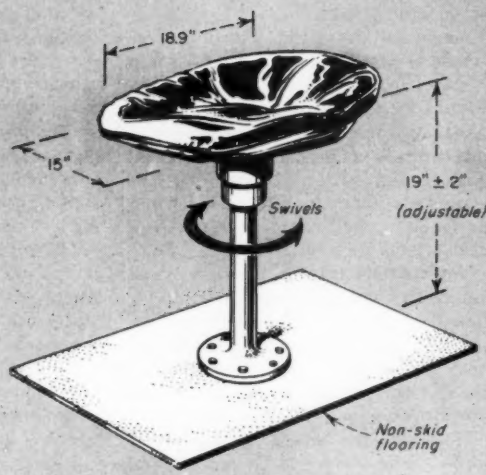
Coal storage and unloading areas should be kept as far as possible from the plant. Permanent storage piles may be coated or top dressed to reduce coal dust picked up by the wind. Coal handling and ash-disposal areas should be on opposite side of plant from prevailing wind direction. Windbreak trees at edge of property and grass cover or other topping for yards prevent movement of sand and dust into the plant.

Inside fans often place entire building under a vacuum, drawing in dirty air. When taking forced-draft fan suction from an area to ventilate it, provide an adequate fresh-air inlet to localize dust in that area of the building. Sometimes a building is placed under a slight positive pressure by using fans and filters to keep out dust.

Plant operators are generally expected to keep plant equipment and immediate areas clean. Mops, soaps, cloths, vacuum cleaners should be made available as needed. Assignment of certain areas and equipment to each shift will place responsibility for a clean plant.

Janitors clean plant floors, hallways, offices, locker rooms, etc. Special crews for window cleaning and painting are usually organized. Electrical maintenance men look after replacement of light bulbs and cleaning of electrical fixtures. Maintenance crews must avoid creating excessive dirt and mess while working and must clean up completely when they have finished.





1 Centralizing controls and instruments at operating station contributes to equipment safety and operator comfort

2 Adequate seating for the operator working long periods is most often overlooked, must be a properly designed unit

HUMAN ENGINEERING—An Aid to

How effective are your arrangements for control panels and control room? This question, often causing heated arguments among plant designers, can be settled by objective tests, devised and run by industrial psychologists—'human' engineers

By DR B J COVNER, *Dunlap and Associates, Inc*

► TECHNICAL DEVELOPMENTS are changing our way of life. In factories we see trends toward automation of both manufacturing and clerical operations. Laboratories and industries make greater use of high-speed computing equipment. Airplanes fly faster and operate during weather conditions that grounded them only a decade or so ago. Power plants produce increasingly large amounts of energy with better and better reliability of service. Household chores have been lightened by mechanization and electrification.

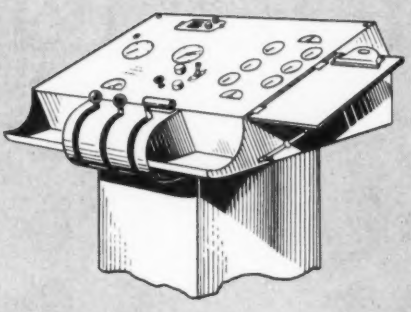
A common denominator of all these developments is the more complicated machinery needed to do a job formerly done by man. The benefits depend on the ability of man to operate and control the machines. Unfortunately, unlike the machine, the human being has not been improving in basic ability. His capacities and limitations are about the same as they were thousands of years ago. When man remains an essential part of a mechanical system he becomes a stumbling block unless the system conforms to his limitations.

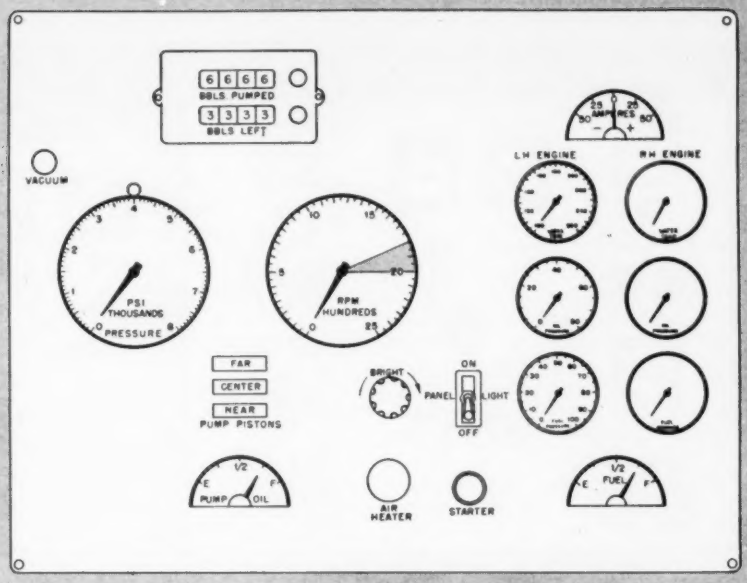
Human engineering, a composite science drawing from psychology, physiology, anthropology and engineering, aims to fit a mechanical system to man's ability. It is concerned with design of products, equipment, work-place layouts, and work processes, for optimum simplicity, ease, safety, and comfort of operation and maintenance, as well as optimum cost, value and investment.

These problems are neither new nor the private domain of the "human" engineer. Engineering managers must make decisions on them every day. The human-engineering specialist can develop additional data that will influence such decisions.

Control station. To show how the human engineer works in fitting a machine to the man, let's review what was done for a special type of pumping unit. This unit, mounted on a truck, pumps a sand and oil mixture at high pressures into oil wells to increase the porosity of the oil-bearing formation. To prevent damage to the well and to the unit itself, the operator must be alert constantly to the changing conditions. The unit runs 24 hours a day under virtually all weather conditions.

In the original design the instruments and controls were arranged so the operator was forced to stand in awkward positions and turn around 180 degrees in doing his work. About 20% of the time he had to divert his attention from important operating instruments. To minimize these conditions the controls and instruments were centralized, Fig.





3 Operator's console provides easy reading of instruments, view of work area

4 Instrument panel groups instruments in logical order, gives prominence to most important indicators. Dial faces and layout utilize human engineering principles

Instrument and Control Design

1 to 4. While this is not a new idea, centralization still awaits application in many work situations. To design a centralized control station, without creating new problems for the operator or excessive costs for the manufacturer, presents quite a challenge.

In this control station the throttles, clutches and shift levers are grouped so the operator uses them without changing his position or taking his eyes off the main pressure gage. The seat is an important feature of the station. It is padded, adjustable in height and fully rotatable. The dimensions are based on anthropometric measurements of male adults. It is amazing how often adequate seating is omitted from work places. In many instances an operator controlling a million dollars worth of equipment will be provided with the crudest sort of hard, nonadjustable seat.

Nonskid flooring, Fig. 2, perforated for drainage of oil, mud and water, contributes to personnel safety. The operator is placed so that blowing heads or gaskets cannot hit him. Making the main pressure gage a relay, rather than a direct-reading gage carrying high-pressure fluid internally, reduces hazard to the operator. A detachable canopy and side curtains contribute to safety during inclement weather. This is often overlooked with equipment used outdoors.

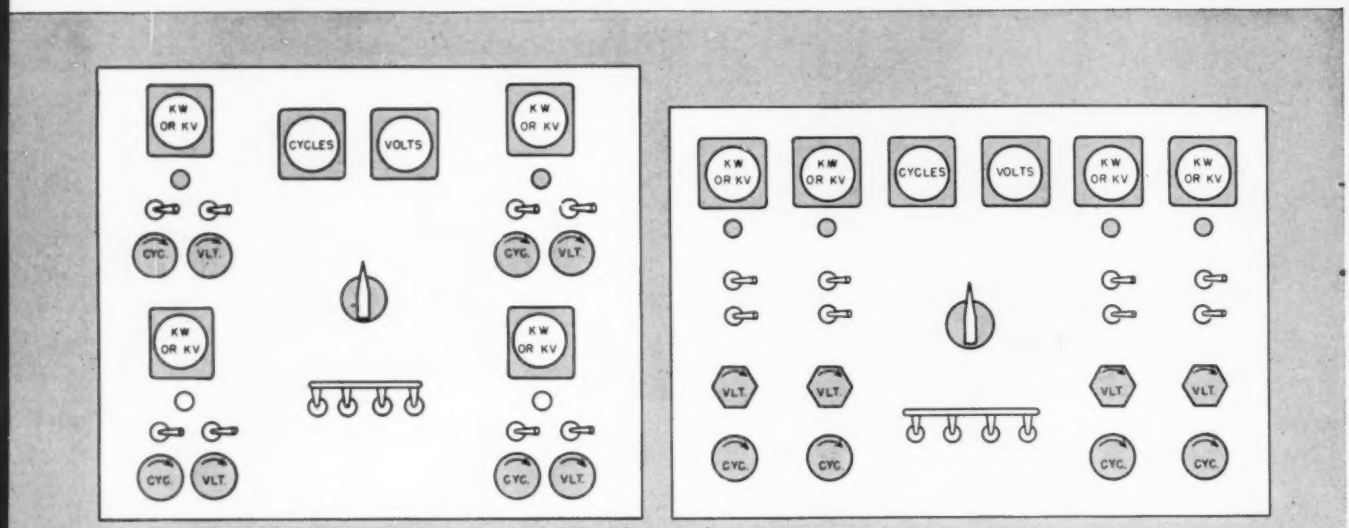
Fig. 3 shows the operator's instrument console. The collapsible writing surface at the right edge facilitates keeping records. Control switch and knob are kept close to the associated instruments. The over-all tilt allows wide visibility without obstructing background objects or personnel.

Fig. 4 shows the instrument panel. Pump performance indicators are grouped at the left, engine instruments at the right. Features of the panel are: (1) pressure gage and tachometer in most prominent position (2) uniform zero position of all instruments (3) horizontal, rather than radial or tangential orientation of instrument letters and numerals (4) clockwise increase of *all* numbers and moving pointers (5) scales in units of five where practical, otherwise in units 10, 50, 100 (6) dial pointers of same or narrower width than markings, and not overlapping markings (7) all indicators clearly labeled (8) dial lettering with stroke length to width ratio of 6:1, height to width ratio of 1:1 (9) edge lighting to eliminate glare and hot spots, to increase legibility and to decrease operator fatigue and eye strain (10) rheostat to permit brightness control from 0.5 to 5.0 foot-lamberts on the dial faces as needed.

Instrument Panel. Another illustration of the services the human engineer can perform centers on Fig. 5 and 6. These rather simple electrical-distribution panels are used by an operator who has many other duties to perform, and has very little opportunity for practice. Results of incorrect operation would be serious, even though the number of actions at the panel would be few. The operator literally has to watch this panel out of the corner of one eye.

Certain limitations were evident in the old model, Fig. 5, so the owner requested proposals from different manufacturers based on Fig. 6. Some manufacturers proposed including a graphic feature consisting of transilluminated plastic strips connecting meter, light, switch and control knobs for each generator. They claimed that operating advantages more than compensated for the added cost. Other manufacturers claimed the opposite. Who was right?

The owner engaged a human-engi-



5 Original arrangement of distribution panel did not place instruments in the same order as generators they represent

6 Proposed arrangement of distribution panel places dials and control knobs in the same order as their generators

neering service to analyze the job requirements, study all the proposals, recommend a single design that could be defended scientifically. The human engineers set up experimental materials to simulate the proposed panel arrangements. The various components—voltmeters, frequency meter, synchronizing lights, rheostats, snap switches, bus bars—were made out of photostatic copies of full-size drawings. Each was cemented to a small magnet that could hold the component in any position on an iron panel of the same size as the instrument panel. This allowed setting up any arrangement within seconds.

The most difficult part of such an investigation is to set up an experimental design that is scientifically sound. A series of trouble-location problems were designed. These were administered to a series of 16 operators under carefully controlled conditions. The time they required to locate the source of difficulty was taken as the criterion to choose the best instrument arrangement. Half of the problems (four in all) used the graphic feature, the other half did not.

Each of the 16 subjects was presented four different versions of the following problems: source of trouble indicated by (1) meter alone (2) meter and warning light (3) meter and bus bar (4) meter, warning light and bus bar.

Performance times were measured by stop watch. Analysis of these times showed no significant difference. The client was then advised not to entail the extra expense of the illuminated bus-bar feature.

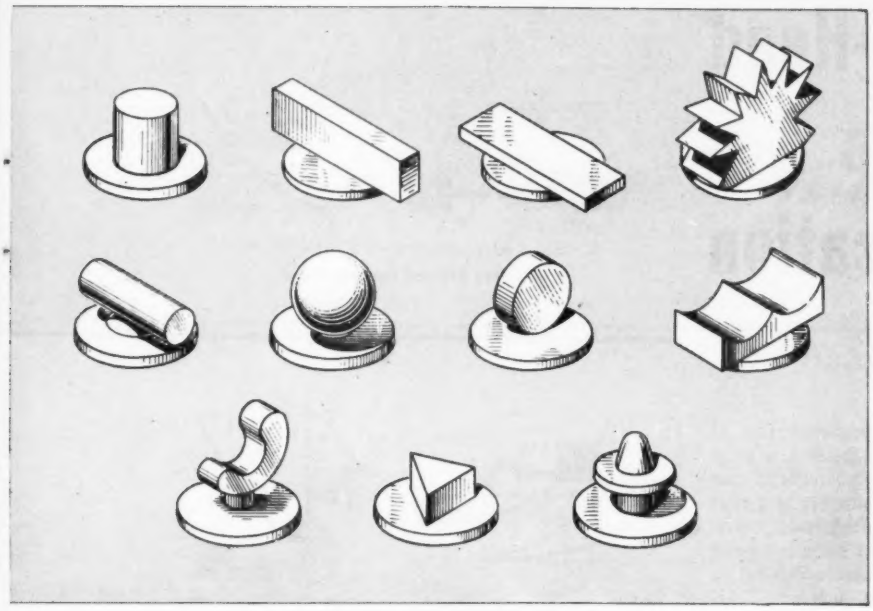
Instrument Simplification. Reducing the number of instruments that an operator must read can sometimes simplify his job. An instrument is justified only when it contributes to decision making. Too often instruments are kept on a control board after their original function has become obsolete.

Sometimes instruments can be combined without increasing reading difficulty. One airline found that fundamental information was given by the difference in readings of two instruments, rather than the individual readings themselves. By combining the two instruments into one with two pointers, the operator need only respond when there is a space between the two pointers. Presumably, further simplification would be to substitute a light that would function when the two variables failed to synchronize.

System Improvement. Much of human-engineering activity concentrates on improving existing control and display devices. A new trend is to look first at the need for the device before attempting to improve it. Man-machine systems have the ultimate aim of producing goods or a service. This should be kept in mind when attempting to improve or modify some internal component of the system. Unfortunately, there often are very complex systems whose performance characteristics no one really knows. This stems from the high degree of specialization of company departments and personnel. Such a situation leads to people getting lost in their worlds without understanding the effect of their performance upon that of others.

Electrical utilities find that centralized control in power plants reduces labor costs. But centralized control often means more instruments to watch and raises questions as to best control-room layout. Increasing use of automatic controls gives the operator less opportunity to practice skills he must use in an emergency. Here we have a curious situation in which the operator has relatively little to do most of the time (leading to boredom), but during an emergency he must immediately do many things he never has done in exactly the same way before. One investigator has pointed out that where automatic equipment is used, there is a strong tendency to neglect even minor maintenance duties so that equipment failures still occur.

Several sources influence decisions on power-plant control, and controversial issues constantly arise. For example, designs of major equipment—boiler, turbine, generator, feedwater system—are each assigned to the va-



7 These knobs are results of a human-engineering investigation. Extensive experimentation shows they help positive identification by an operator, minimize error

rious experts in those fields. But the over-all information on the operation of all these components is fed into a single room. One man often must operate all these units with understanding and skill.

Some power-plant experts wonder whether too much is being asked of the operator. They realize that they must distinguish between facts and fancies or fads. They wish to supplement their engineering knowledge with factual information on human behavior. More dependable information is needed on such things as: color of instruments, color of panels, use of graphics, heights of instruments, relationship between switches, relays, protective devices and measurement of important related variables.

Many of these items are controversial issues that must be faced every time a new installation is considered. In some instances, the buyer has strong opinions that all switches and controls should be clustered, and separated from the related instruments. Other buyers feel just as strongly that switches and controls should be arranged directly with associated instruments. Issues of this nature cause difficulty where buyer-designer relations must be kept amicable.

In a paper before the Pennsylvania Electric Assn, John G Fleming, The Bristol Co, showed that as boiler capacities increased the number of insurance claims increased:

Plant capacity, 1000 lb steam per hr	*Number of claims yearly*
25 to 30	One for every 58 boilers
100 to 400	One for every 17 boilers
900 and up	One for every 8 boilers

Claims vary from very expensive to minor. Many of the causes can be attributed to the human element. He points out that the modern power plant is a man-machine system in which the interconnecting link is the instrument and the automatic controller. The engineer must be supplemented by those who understand the characteristics of man so that the over-all system requirements can be established.

Plant instrument users demand meters of greater readability. But this represents only a surface attack on the problem. It is more important to find out what kind of information is needed in the first place and how valuable an effect the use of certain indicators will have on system performance. System analysis has shown repeatedly that being able to do certain things better can actually cause poorer over-all system performance.

Survey. Observation of control-room activities in a power plant during a single watch period uncovered these conditions that could cause operating mistakes:

1. The system frequency meter, a major indicator, was on a side panel rather than the main board.

2. The frequency meter had a range of 58 to 62 cycles with graduations of 0.1 cycles. Spacing of graduations decreased with increasing distance from midpoint of 60 cycles, making it difficult to estimate pointer position from center of room.

3. A voltmeter with 0- to 20-kv range was marked for normal operation at 13.8 kv. The meter face had white figures on black background, with 13.8 kv marked in red. Meter could not be read accurately because red did not contrast sufficiently with the black, and blunt dial pointer obscured scale markings.

4. Recording voltmeters and ammeters could not be read accurately because of thick stylus line; recording paper could be moved appreciably because of loose fit in drive sprockets.

5. Controls on the main board were not arranged in a pattern similar to their indicators. This increased chances of operator using wrong control.

6. Indicators on panel were legible at no more than two feet from panel. Some meters were too high to be read without parallax errors.

7. Meters on back of board were only 12 to 30 inches above floor. Making operator squat to read increases chance of error.

8. Four movable telephones had lights on a panel to indicate which was ringing. But since phones were being moved about their position bore no relation to the lights. Several times operator picked up wrong phone.

9. Totalizing wattmeters on back of the main board required hourly check readings. Possible danger signals appearing on the front indicators would be missed by an operator who was reading the meters in back.

10. Load indicator in the turbine room was in such a position that the control-room operator had to lean out of a window and crane his neck to check its reading.

Summary. Problems of instrumentation and control that human engineers have dealt with to date are similar to those currently found in central stations. Human engineering appears to offer a ready means of improving the effectiveness of control panels and their individual components. It is important to analyze the man-machine system as a whole to determine both the need and the value of specific improvements.

Using System-Head Curves in Pump Choice, Application

By **MELVIN MANN**, *Chief Proposal Engineer*
Peerless Pump Div, Food Machinery and Chemical Corp

► A SYSTEM-HEAD CURVE is a graphical representation of the relationship between flow and hydraulic losses in a given piping system. Since hydraulic losses are functions of rate of flow, size and length of pipe, and size, number and type of fittings, each system has its own characteristic curve.

Use. In virtually all pump applications at least one point on the system curve is given to the pump manufacturer to help him select the unit properly. Often, however, it is highly desirable to graphically superimpose the entire system curve over the head-capacity curve of the candidate pump. Intersection of the pump curve with the system-head curve defines the pump's operating point.

By typical examples this article reviews methods of calculating system heads for some common piping layouts and discusses some of the factors revealed by superimposing system curves over pump-performance curves.

Hydraulic losses in piping systems are composed of: pipe friction losses; fitting losses (valves, elbows, etc); entrance and exit losses (these normally occur at the beginning and end of a pipeline, respectively); losses due to change in pipe size by sudden or gradual enlargement or reduction in pipe diameter.

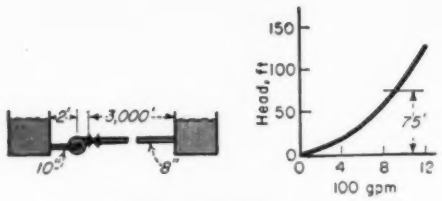
In application of low-head high-capacity pumps, such as mixed-flow or axial-flow units, it is imperative that, when applicable, each of these losses be accurately accounted for, because they usually represent a significant fraction of the total system head. But in applications involving relatively high static lift, or relatively high pipe fricton losses (long lines), or both, it is usually unnecessary to account for losses other than pipe friction, since these other losses are an insignificant portion of the total head.

Except for our first two examples, we will take into account only losses resulting from pipe friction. In actual practice, however, each application should be checked to find out the order of magnitude of the various hydraulic losses. A decision can then be made as to what losses should be computed and what ones neglected.

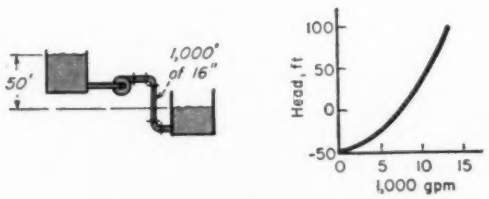
No Lift. System-head curve, Fig. 1, starts at zero flow and zero head when there is no static lift. Since friction losses vary as the square of flow rate, this system curve is parabolic in shape, has a steep slope.

Here's how the point for flow of 900 gpm is figured:

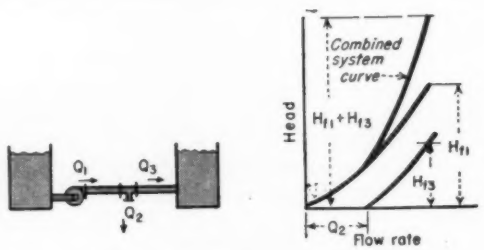
Entrance loss: tank into 10-in. suction pipe = $0.5V^2/2g$ =	0.1 ft
Friction loss in 2 ft of suction pipe =	0.02
Loss in 10-in. 90-deg elbow connected to pump (equivalent to 25 ft of 10-in. pipe) =	0.2
Friction loss in 3000 ft of 8-in. discharge pipe =	74.5
Loss in 8-in. gate valve fully open (equivalent to 5 ft of 8-in. pipe) =	0.12
Exit loss from 8-in. pipe into tank = $V^2/2g$ =	0.52
Total friction loss, H_f =	75.46 ft



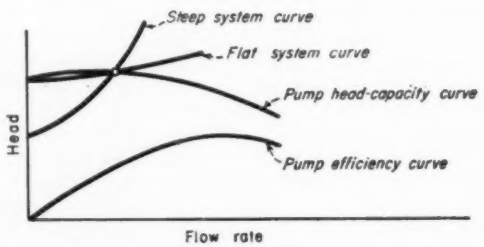
1. No lift—all friction head



4. Negative lift (gravity head)



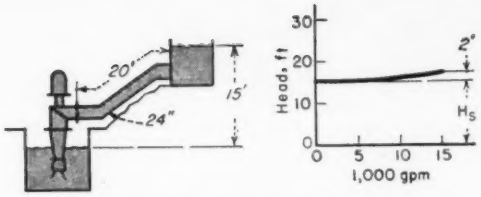
7. Part of flow diverted elsewhere



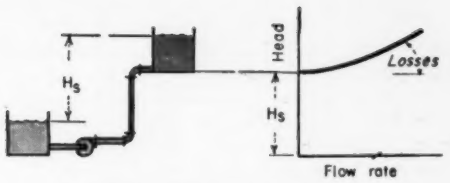
10. Low specific-speed pump near shutoff

Friction losses at other flow rates can be computed and plotted to get the system-head curve shown, Fig. 1. If all losses were ignored except friction through the discharge pipe, the total system head would not change significantly.

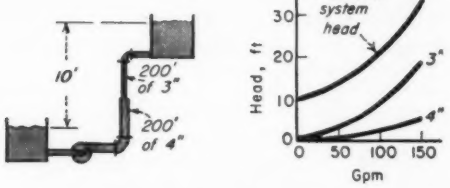
Mostly Lift. System-head curve, Fig. 2, starts at the static lift H_s and zero flow. Since, by assumption, friction loss H_f is relatively small compared to H_s, we get a flat system curve. This is the calculation for 15,000-gpm flow:



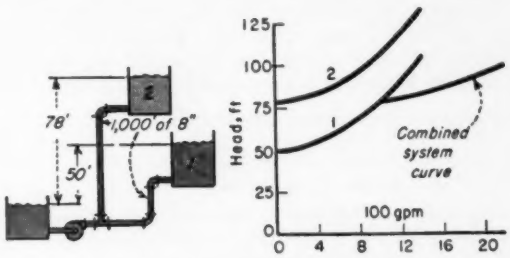
2. Mostly lift—little friction head



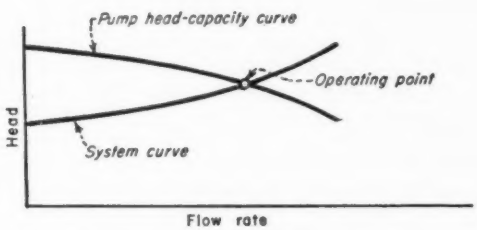
3. Significant friction loss and lift



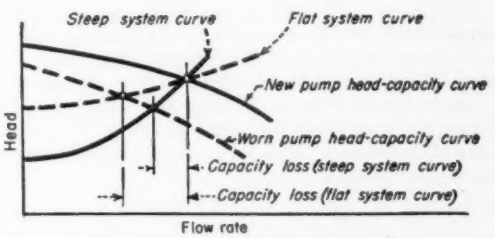
5. Two different pipe sizes



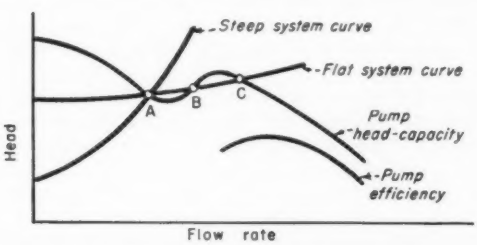
6. Two different static lifts



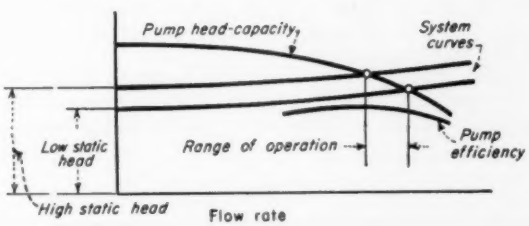
8. Defining the operating point



9. Effect of pump wear on capacity



11. High specific-speed pump near the dip



12. Variations in system head

Friction loss in 20 ft of 24-in. pipe =	0.4 ft
Exit loss from 24-in. pipe into tank = $V^2/2g$ =	1.6
Total friction loss, H_f	= 2.0 ft

In this example, almost 90% of the total head of 17 ft at 15,000 gpm consists of static lift. However, it should be noted that neglecting the friction and exit losses would result in an appreciable error.

Combination of these two cases is encountered quite often, Fig. 3. Here both friction head and static lift are appreciable. As can be seen in Fig. 3, system-head curve resembles Fig. 1, with the addition of static lift.

Negative Lift. Installation in Fig. 4 has flows up to 7200 gpm by gravity head alone. To obtain flow rates beyond this, however, requires a pump to overcome the pipe friction losses in excess of 50 ft. Following data define three points

on the system-head curve that we have plotted in Fig. 4:

At 5000 gpm, friction loss in 1000 ft of 16-in pipe = 25 ft
At 7200 gpm, friction loss = available gravity head = 50
At 13,000 gpm, friction loss = 150

Different Pipe Sizes. Here, Fig. 5, friction losses vs flow rate are plotted independently for the two pipe sizes. At any given flow rate the total friction loss for the system is the combined loss for the two lines. Thus the combined system curve represents the sum of static lift and the friction losses for all portions of the line.

At 150 gpm, friction loss H_{f1} in 200 ft of 4-in. pipe = 5 ft
At 150 gpm, friction loss H_{f2} in 200 ft of 3-in. pipe = 19
Static lift, H_s = 10 ft

Total head, H, at 150 gpm = 34 ft

Two Lifts. System curves, Fig. 6, are plotted independently for the two lines when static lifts are different. The total system curve is then obtained by adding flow rates for the two lines at the same head.

At 550 gpm, friction loss in 1000 ft of 8-in. pipe = 10 ft
At 1150 gpm, friction loss = 38
At 1150 gpm, friction + lift in line 1 = 38 + 50 = 88
At 550 gpm, friction + lift in line 2 = 10 + 78 = 88

Therefore, the flow rate for the total or combined system at a head of 88 ft is 550 + 1150 = 1700 gpm. Thus, to produce a flow of 1700 gpm through this system a pump capable of generating 88-ft head would be required.

Diverted Flow. In this case, Fig. 7, a constant quantity is assumed to be tapped off at the intermediate point. Friction loss vs flow rate is plotted in the regular manner for Line 1. Curve for Line 3 is displaced to the right at zero head by an amount equal to Q_3, since Q_3 represents the quantity passing through Lines 1 and 2 but not through Line 3. The combined system curve is obtained by adding, at a given flow rate, the head losses for Line 1 and 3.

Assume Q_3 is 300 gpm, Line 1 has 500 ft of 10-in. pipe, and Line 3 has 50 ft of 6-in. pipe:

At 1500 gpm through Line 1, friction loss = 11 ft
Friction loss for Line 3 (1200 gpm) = 8

Total friction loss at 1500-gpm delivery = 19 ft

Operating Point. Superimposing the system curve on the pump-performance curve shows at what point the pump will operate, Fig. 8. Shape or slope of both system curve and pump curve are significant in certain applications, as shown in the following examples.

Wear. When a pump wears there is certain to be a loss in performance. Amount of loss for a given amount of wear, however, depends to a large extent on the system characteristics. As Fig. 9 shows, capacity loss is greater for a given amount of wear if the system curve is flat as compared with a steep system curve.

Shutoff Point. A characteristic of low-specific-speed pumps is a relatively flat head-capacity curve at capacities near shutoff. Occasionally it is necessary to pick such a pump because of a high-head low-flow requirement. (Ordinarily pumps are physically capable of operating continuously near shutoff). If this is the case, the system curve should certainly be examined before specifying the pump.

Fig. 10 shows that a shallow or flat system curve in conjunction with a flat pump curve can lead to performance trouble if the pump is slightly off in head-capacity or if the system curve is calculated slightly too low.

With a steep system curve no hydraulic performance trouble would be expected.

High Specific-Speed. A characteristic of some high specific-speed pumps is that the head-capacity curve dips at capacities to the left of peak efficiency. Occasionally the need arises to operate pumps at or near the dip. To see whether performance under these conditions would be satisfactory let us look at the system curve.

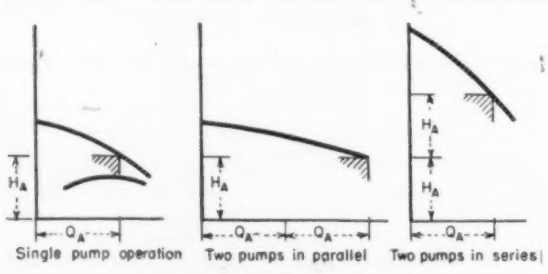
Suppose A, Fig. 11, is the desired operating point, for some transient high-head condition. With a steep-system curve, no trouble should be encountered. A shallow-system curve, however, which intersects the pump curve at three points, might result in unsatisfactory operation if the pump hunted between the three capacities.

System-Head Changes. Demand of a system can vary as a result of changes in suction or discharge surface levels or greater pipe friction from increased pipe-surface roughness. Conditions shown in Fig. 12, where the static head is varied, represent a favorable operating range as far as the efficiency of this particular pump is concerned. Fig. 12 also shows the magnitude of drop in system flow when a high head condition occurs.

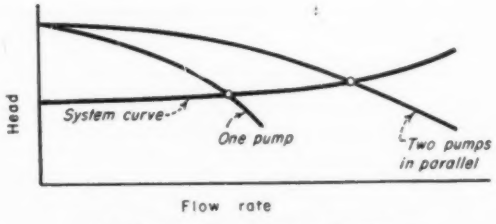
Parallel or series operation, Fig. 13, can introduce problems, too. Frequently where there is a wide range in demand two or more pumps may be operated in parallel or series to satisfy the high demand, with just one of the pumps used for low demands. For proper specification of the pumps and evaluation of their performance under various conditions, the system curve should be used in conjunction with the composite pump-performance curves.

For pumps in parallel, Fig. 14, performance is obtained by adding the capacities at the same head. For pumps in series, performance is obtained by adding the heads at the same capacity.

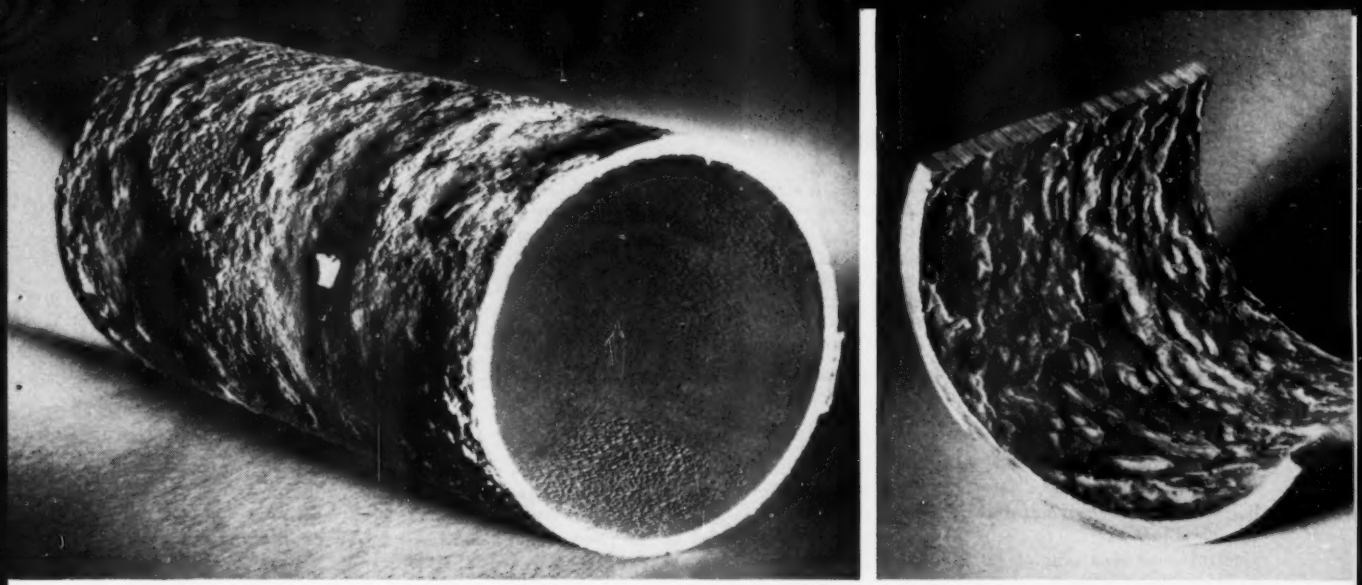
Superimposing the system curve on the pump performance curves clearly indicates what flow rates can be expected and at what heads each of the pumps will be operating.



13. Parallel or series operation



14. Pump performance in parallel



CORROSION, strong power-equipment enemy, comes under ready control by the proper use of hydrazine, say some early users

Hydrazine: New Aid To Water Treatment

Speculation and wonder characterize today's power-field knowledge of hydrazine, latest entry in water-treatment field. Here are the first reliable, factual data to come to light

By ERIC R WOODWARD, *Mathieson Chemical Corp*

► CORRECT BOILER FEEDWATER treatment is recognized as a primary essential in efficient steam production for power generation, industrial processing and other uses. The reason is that natural waters for steam making contain impurities, such as dissolved gases, mineral salts, silica, and suspended matter of mineral or organic origin.

Rain, the source of all natural-water supplies, contains appreciable amounts of dissolved oxygen and carbon dioxide, both of which are corrosive gases under steam-generating conditions.

In view of the variety of treating problems no individual chemical is a cure-all. Further, with continual boiler-design developments, new water-treatment methods become essential to replace older, inadequate ones.

Hydrazine compounds, newcomers in this field, prevent corrosion due to dissolved oxygen. The way they do it, by their own oxidation, has been studied extensively. The exact oxidation products depend on the reagent used, and the application conditions. Complete oxidation, for example, gives nitrogen and water, but incomplete oxidation can yield ammonia.

In its simplest form the complete oxidation reaction follows this equation:

$$N_2H_4 \cdot H_2O + O_2 = 3H_2O + {}^{1}N_2$$

Hydrazine compounds already in use in the U.S. for boiler feedwater treatment are hydrazine hydrate ($N_2H_4 \cdot H_2O$) for high-pressure boilers up to 1400 psig, and dihydrazine sulfate $(N_2H_5)_2 \cdot SO_4$ as an ingredient of boiler compounds for low-pressure industrial-plant boilers.

Still another hydrazine compound, dihydrazine phosphate $(N_2H_5)_2 \cdot HPO_4$ is used in England for laying up idle boilers. This service developed from experimental pilot-plant studies with hydrazine compounds in an idle boiler, filled completely with tap water containing 6.4 ml per l of oxygen. Tests showed that the stoichiometric requirements of hydrazine to remove available oxygen, plus 25% excess, gave excellent protection from corrosion due to dissolved oxygen.

Both hydrazine hydrate and dihydrazine phosphate work well in this duty. The hydrate reacts more rapidly than the phosphate, taking 6 to 8 minutes to remove all oxygen completely, while the phosphate requires a total of 20 minutes.

Adoption of hydrazine to this and other commercial practice proves its best recommendation. Although the technical press has as yet published no authoritative article giving detailed results of hydrazine use in the U.S., it is confidently expected that such an article will appear within the next few months. Right now, we summarize reported trials made in England on a 650-psig boiler with hydrazine as a deoxygenating agent in boiler feedwater and follow up with a German report on its role as a degassing agent.

ENGLISH EXPERIENCE

Test Conditions. Oxygen content of feedwater was mechanically reduced to about 0.04 ml per l to determine the effectiveness of hydrazine in scavenging the residual oxygen. Ammonia content of the system ran normally high, about 0.3 ppm.

In all tests with hydrazine injection, no other boiler-conditioning chemicals were injected. This presented the op-

I: Reaction of Oxygen With Hydrazine

Temp, deg C	Reaction time, minutes	Hydrazine %, reacted in presence of: 1 mg Mn as $MnCl_2$	0.1 mg Mn as Mn Cl_2	1 mg Fe as Fe SO_4	1 mg Fe & 0.1 mg Mn	Without addition
20	5	72.5	19.3	3.7	25.3	11.0
20	10	93.5	26.2	9.4	41.8	12.9
20	20	97.8	59.0	16.2	43.8	29.4
60	5	96.3	77.8	29.7	58.5	58.0
60	10	98.0	94.2	37.5	77.0	79.0
60	20	—	97	65.7	97.0	82.0

II: Corrosion Test—Iron-Content Increase (mg Fe)

Time, hr	Condensate without addition	Condensate & 0.6 g Na_2SO_3/l	Condensate & 10 g Na_2SO_3/l	Condensate & 0.6 g hydrazine hydrate	Mg of hydrazine present
0	0.02	0.02	0.02	0.04	364
1	0.06	0.02	0.02	—	—
2	1.2	1.7	0.02	0.04	364
4	9.1	6.4	0.12	—	—
8	24.5	14.0	6.9	0.02	325
24	70.0	47.0	42.0	0.08	283
48	—	—	—	0.18	168

timum pH conditions for the hydrazine-to-oxygen reaction in feedwater, namely 8.5 to 9.0. Feed temperature at the injection points was 180 to 190 F. Hydrazine injection took place from Monday to Friday only, so week-end operation of the boilers brought the system back to normal conditions, providing reference data for the rest of the week. Further, injection was made only during the steaming hours of the boilers, roughly some 16 hours a day.

Test a: 700-800% excess hydrazine. Hydrazine was injected for one week to give 0.5 to 0.6 ppm in the feed. This corresponded to 800-1000% excess hydrazine based on the theoretical oxygen requirements.

Almost immediately hydrazine appeared at the feed pump and after a day or two in the surge tank and deaerator, showing it (1) is reasonably stable (2) can withstand the 185-F temperature, existing in the 30-ft length of feed main (3) can pass through the deaerator. No hydrazine could be found in the steam condensate. This occurrence of hydrazine, at all points except the steam sample, made analysis more difficult. It took several days to devise, check and pronounce satisfactory the modifications required in the analytical technique for the determination of oxygen and ammonia in the presence of hydrazine. It requires very great accuracy to test for oxygen of .01 to .02 ppm or less, and all traces of hydrazine must be removed.

The technique finally adopted, wherever hydrazine showed in the sample, was to (1) reduce rapidly the pH of the sample immediately after it had been taken, thus fixing the hydrazine (2) determine the ammonia in the usual way. Oxygen was determined by the electrometric method, after first removing the hydrazine by oxidation with permanganate.

The hydrazine in the injection solution was determined by direct titration with potassium iodate in acid solution, in the water after injection by the Pasoz and Petit method employing paradimethyl-amino-benzaldehyde reagent.

Results indicated that oxygen was definitely scavenged by hydrazine and, what is more, that oxygen and hydrazine do not coexist in solution. When hydrazine appeared at the preinjection point, oxygen contents of condensed steam, feed-pump water and preinjection water all ran about 0.005 ml per l, considered the threshold value of the oxygen method of testing. Ammonia in the system did not rapidly increase, as was thought possible, but began to rise after two or three days' operation, becoming as high as 0.9 ppm in the surge tank by the fifth day. A sample of condensed steam, taken when the boiler ceased steaming on Friday, showed ammonia as high as 1.1 ppm. Conductivity of the condensed steam increased to 6-7 units as the ammonia increased.

Test b: 150-200% excess hydrazine. When ammonia in the system dropped back to normal, oxygen tests, carried out before injecting hydrazine, showed a low oxygen level in the steam, despite a normal feedwater oxygen, indicating that oxidation was occurring within the boiler or feed main, or somewhere after the feed pump. Possibly it was oxidation of lower iron oxides produced during the hydrazine-injection period.

Concentration of hydrazine was reduced then for Test b's run to about 0.15 ppm in the feed as against Test a's 0.5 to 0.6 ppm. Quite different results developed. No hydrazine recirculation occurred through the surge deaerator system, nor was any significant rise in ammonia concentration detected, although, as has been pointed out, slight decomposition into ammonia might be masked by a generally high ammonia content normally present in the system at that time. A still further difference was that hydrazine and substantial oxygen concentrations were obtained together at the feed pump, probably because the greatly reduced hydrazine excess did not permit the chemical reaction to go to completion at this point.

Oxygen content of the steam was again reduced to virtually zero, showing the injection of only 150-200% excess material was apparently satisfactory.

Other Tests. Up to now, we've made no reference to pH value. A study of the pH figures shows that these cannot be correlated with ammonia content, also that carbon dioxide ingress must have been playing a variable and active role. This was strikingly borne out at the end of the second week's operation, that is the end of Test b, when pH measurements were made on the steam after the boiler was banked. Coincident with a rise in steam, conductivity and ammonia to 8.0 units and 0.44 ppm respectively, pH dropped to 4.8 several hours after the boiler came off load. Some unevaporated, undeaerated makeup water, containing carbon dioxide, was believed to have entered the boilers on shutting down.

Water samples went to the laboratory to confirm ammonia determinations, and to test for albumenoid ammonia. As expected, albumenoid ammonia was nil or very small.

Physical appearance of the boiler waters, after hydrazine injection, was significant. Normally, suspended matter from these boiler waters is large in quantity, consisting mainly of easily filterable red ferric oxide. During hydrazine treatment, the quantity of sludge appeared less, and the color, while still red, was less intense. Further, it was very finely divided and almost impossible to filter. The hydrazine may have some reducing effect in the boiler or, more probably, there was an absence of oxygen within the boiler, confirming the finding that oxygen removal could still take place within the boiler plant when hydrazine injection ceased.

Summary. This three weeks' trial of hydrazine as an oxygen scavenger led to these first indications: (1) Hydrazine is an excellent oxygen scavenger. (2) When equilibrium conditions are established, hydrazine and oxygen do not appear to exist together in solution. (3) Hydrazine proves more stable than had been supposed, and does not immediately decompose at temperatures of 185 to 190 F. (4) Main decomposition product of the excess hydrazine used is not ammonia under the operating conditions. Ammonia, however, forms under certain circumstances.

Possible hydrazine after effects, and

HYDRAZINE CHEMICAL AND HANDLING PROPERTIES

HYDRAZINE HYDRATE (85%)

Chemical formula:	$N_2H_4 \cdot H_2O$
Formula weight:	50.05
Grade:	Technical
Min active ingredient:	54% N_2H_4
Typical analysis:	N_2H_4 54.6% Cl^- 0.03%
Appearance and form:	Colorless, mobile liquid
Pounds per gallon:	8.59 at 25 C
Solubility:	Completely miscible in water and methanol
pH:	9.9 (1% solution at 25 C)
Viscosity:	1.45 centipoises at 25 C
Refractive index:	1.414 n_D^{20}
Surface tension:	75.1 dynes cm at 25 C
Melting point:	Minus 57 C
Boiling point:	119.8 C
Flash point:	193 F, open-cup method
Fire point:	204 F, open-cup method

Storage: Store in a cool area; keep container tightly closed when not in immediate use. Avoid contact with oxidizing agents

Handling: Although hydrazine hydrate (85%) is particularly recommended for industrial use because of its lower concentration of hydrazine, the handling precautions may well be considered the same as those applying to hydrazine hydrate (100%) and anhydrous hydrazine

In the design of industrial scale equipment for handling anhydrous hydrazine, and the hydrazine hydrates (both 100% and 85%), stainless steel 304 or 347, fabricated by helium-arc welding, is usually suitable. Glass-lined steel is satisfactory, but unsupported glass is not recommended for large equipment because of the possibility of breakage

Availability: Commercial quantities

Containers: 55 gal (440 lb, net)
30 gal (240 lb, net)
Stainless-steel drums, returnable
Warning label: White label (corrosive liquid)
Also available in 5-pint bottles

Industrial Utility: Hydrazine has long been recognized as a versatile chemical and its industrial utility has, in many cases, been established

It is a powerful reducing agent for both inorganic and organic chemicals. Its ability to reduce metal salts or oxides to the free metal is being utilized, for example, to plate silver on glass, metals and plastics

HYDRAZINE HYDRATE (100%)

Chemical formula:	$N_2H_4 \cdot H_2O$
Formula weight:	50.05
Grade:	Technical
Min active ingredient:	64%, N_2H_4
Typical analysis:	N_2H_4 64.2% Cl^- 0.03%
Appearance and form:	Colorless, mobile liquid
Pounds per gallon:	8.61 at 25 C
Solubility:	Completely miscible in water and methanol
pH:	9.9 (1% solution at 25 C)
Viscosity:	1.5 centipoises at 25 C
Surface tension:	74.2 dynes cm at 25 C
Refractive index:	1.4284 n_D^{25}
Melting point:	-51.7 C
Boiling point:	120.1 C
Flash point:	163 F (72.8 C)—open-cup method
Fire point:	166 F (74.4 C)—open-cup method

Handling: The properties of hydrazine hydrate (100%) are similar to those of anhydrous hydrazine, differing so slightly that the same handling methods and precautions are generally applicable

Availability: Commercial quantities

Containers: 55 gal (440 lb, net)
30 gal (240 lb, net)

Industrial Utility: For details covering the utility of hydrazine, refer to heading under 85% hydrazine hydrate

how they may influence subsequent tests must be considered. For example, it is possible that hydrazine can behave in a boiler plant in three ways: (1) Primarily it will scavenge free oxygen, giving water and nitrogen as products. (2) Excess hydrazine will then reduce metallic oxides, giving the same products as (1). (3) In absence of oxygen or oxides, catalytic or thermal decomposition takes place with the formation of ammonia and nitrogen.

Action (1) is the desirable one, while (2) must occur, especially in old plant where much oxide scale exists. Action (1) may account for various joint leaks, etc, that occurred in the feed system of test cases (1) and (2), and also for the water phenomenon.

Action (3), definitely undesirable, may occur if action (2) reaches equilibrium, when further excess hydrazine decomposes into ammonia. Ammonia appearance in the trials during the heavy injection of hydrazine supports this view.

Hydrazine is valuable for feedwater treatment, and provided ammonia is not a decomposition product its use does not add impurities to the system. Economically, it compares very favorably with sulfite injection.

Treatment Costs. This statement can be amplified by an example from American practice. In an industrial power plant having nine boilers of 600-psig-design working pressure, where sodium sulfite is used as the deoxygenating agent, cost for sodium sulfite averages $1 per day per boiler.

Calculate equivalent costs for 85% hydrazine hydrate at its present price of $1.55 per lb (one to nine 240-lb drums f.o.b. Niagara Falls, New York) as follows:

	Ppm
Oxygen content of water	0.08
Equivalent hydrazine (N_2H_4)	0.08
Hydrazine residual desired	0.04
	0.12

Since 100,000 lb of water requires 0.012 lb N_2H_4, 0.012 × 24 equal 0.288 lb N_2H_4 per day. Now 85% hydrazine hydrate contains 54% N_2H_4, or 0.288 ÷ 0.540 = 0.533 lb hydrazine hydrate per day. Cost per boiler: 0.533 lb at $1.55 per lb is $0.83 per day.

Data for this English report supplied by Whiffen & Sons, London, England.

GERMAN REPORT

Degassing Process. There is a definite demand for a chemical degassing agent not affected by the disadvantages of sulfite. In recent years the industrial production of hydrazine points the way to a solution. Hydrazine combines with oxygen dissolved in water in accordance with the equation: N_2H_4 plus O_2 equals N_2 plus 2 H_2O. Thus two perfectly harmless compounds, nitrogen and water, form 32 grams of hydrazine, being able theoretically to bind 32 grams of oxygen, while 252 grams of sulfite are required for 32 grams of oxygen.

Hydrazine, available on the market as a hydrate and added to feedwater in that form, is highly alkaline and, hence, can form salts with acids and also, of course, with any CO_2 that might still be present. Thus, if a certain excess is pres-

(*Continued on page* 212)

Steel Mills Fight Their Pollution Problems

BLAST FURNACES, important producers of pig iron, can cause air pollution

► INDUSTRY AND LOCAL ENFORCEMENT agencies today recognize the full import of air- and stream-pollution problems. As a result, the emphasis on clean-up is shifting from the power field with its relatively high performance level, POWER, April, p 73, to the manufacturing and process industries. Studies and experiments these industries are carrying out point the way to many advances of vital interest to power services engineers.

Take the steel industry as an example. In one year its fuel requirements run over a billion gallons of fuel oil, several hundred billion cubic feet of natural gas, 17 million tons of coal for power boilers, 94 million tons of coal for coke to blast furnaces.

The problems of air-pollution control facing this industry have been tremendous.[1] Out in the Allegheny County area of Pennsylvania a Smoke Control Ordinance, passed June 1, 1949, provided for a research program to be undertaken by the steel industry on its individual difficulties. So the Jones & Laughlin Steel Corp, Pittsburgh Coke & Chemical Co, U.S. Steel Co combined in a joint research program committee. That committee reflected a very practical outlook by a membership made up of operations, research and technology people.

Their over-all assignment was to determine practical methods for controlling emissions caused by blast-furnace slips, open-hearth furnaces, bessemer converters. This committee has done a lot. Some of its findings are being put into operation. In fact, beginning on the facing page a case history report tells how one company has tackled a single phase of these special problems with considerable success. But first let's look at the available reports on the steel industry's pollution-control progress.[1, 2]

Open Hearths. Most of the reported work on open-hearth problems occurred on oil-fired furnaces. Dust loadings, they found, varied widely from almost zero to peak loads as high as 2 gr per cu ft. These loadings stretched over the six major periods of open-hearth operation—the melt down, hot-metal addition, ore boil, lime boil, working heat and empty furnace—with the peaks developing at hot-metal addition, ore-boil, lime-boil periods, and when working with oxygen.

Particle size broke down into about 50% by weight running smaller than 5 microns (one micron = 1/25,400-in. dia), and only a few percent 20 microns or above. Many particles run less than one micron. The chemical analysis showed an iron oxide content of about 90%. Incidentally one point of particular interest was a complete lack of correlation between color of open-hearth discharge and its dust loading, so the Ringelmann Chart made no sense here at all.

[1] *Some Experiences With Air Pollution Abatement in the Steel Industry*, C A Bishop, Research Associate U.S. Steel Co, before the Air Pollution Prevention Assn, Cleveland, Ohio, June 1952.

[2] *Open Hearth Dust Control*, by S Vajda, Office of Chief Engineer, G M Dreher, General Technical Dept, Jones & Laughlin Steel Corp, before the Air Pollution Prevention Assn, Cleveland, Ohio, June 1952.

To render the stack virtually clear means a 95 to 98% reduction in the stack emission. (*Ed. note*: Up in the range of today's power plant collectors, POWER, April, p 73). But the cost of installing and operating the available dust-collecting devices[2] to give this dust-removal performance is so high as to be prohibitive for practical purposes.

Out in Los Angeles County, where, to our knowledge, you'll find the only open-hearth gas-cleaning installation now being used in the country, you run into a different set of conditions. There dust loadings average 0.8 gr per cu ft, all the metal charge enters the furnace as scrap, as against blast-furnace iron supplies in the Pittsburgh area, and the fume contains large amounts of zinc and relatively little iron oxide.

How about gas-fired open hearths? The American Steel and Wire Co at Donora, Pa. uses natural gas and reports dust loadings down around 0.02 to 0.07 gr per cu ft against a 0.43 gr per cu ft average with oil. The dust loading ranges from 0.1 to 0.4 gr per cu ft on an average when natural and coke-oven gases are employed.

But while the loading drops, the particle-size distribution gets tougher. About 90% by weight run smaller than 5 microns. Stack gas seems particularly dirty with this size distribution and makes color comparisons completely unrealistic as far as total dust-loading judgment goes.

Blast Furnaces. Cleaning blast-furnace gas has long been an established art. Today, more than 7,000,000 cfm are being cleaned in the blast furnaces in this country. Results have been excellent, POWER, Sept 1951, p 96. The quantity of gas scrubbed and the waste waters involved, though, have led to still another problem, that of stream pollution. One solution we present just below.

Over and above the well-understood problems of cleaning gas from those furnaces that produce basic pig iron are the relatively fewer, but more stubborn, ferromanganese blast furnaces whose difficulties prompted special treatment.

The gas-cleaning equipment differs sharply because the gas loading is so different. What's more, there are two types of dust coming off a ferromanganese blast furnace. One, comprising about 20% of the dust present, consists of particles of about 20 microns that seem to develop when the coke and ferromanganese burden disintegrate. A conventional dust catcher can remove this fraction. But the other 80% is a different story. It is a typical fume with particle sizes ranging from 0.10 to 1.0 micron and dust loading, averaging about 7.5 gr per cu ft. It forms as a result of vaporization and condensation.

High-energy wet washers will clean this type fume. But maintenance costs run high since the collected ferromanganese has very definite cementing properties. Over and above this consideration was the fact that a rather elaborate water-treating plant would have to go in (see the case history following).

Sonic coagulators for agglomerating the fume had been studied in a preliminary fashion by others. Their findings indicated a required gas-retention time in the sound chamber of over three seconds at a sound-pressure intensity of above 160 decibels. Converted to economic terms, sonic agglomeration at its present state of development lacked definite appeal.

What U.S. Steel elected to install was a dry electrostatic precipitator that handles a specially conditioned gas. They set up a pilot plant to study the various steps involved, and as a result of these studies a plant has been designed and is under construction to clean 135,000 cfm of ferromanganese blast-furnace gas.

The major operating considerations were (1) a spray tower for conditioning the gas, (2) an electrostatic precipitator, (3) a special briquetting process involving a pyrophoring kiln.

The dirty gas, to be treated, first enters a spray cooler at an average temperature of 700 F. This cooler operates without any water effluent to cool and humidify the gas with a 350-F exit-gas temperature. It is absolutely essential that all spray water be evaporated in this unit. Any bottom drip causes the fume to form a hard-setting cement. Incidentally, somewhere around 10% of the solids in the gas leave this tower as a dry material.

From here, the gas passes through a 98%-efficient plate-type electrostatic precipitator, and then to power boilers for duty as a fuel. The visible effect of gas cleaning from the pilot unit on the boiler stack was impressive indeed. No discernible fume was emitted at all, while other boilers handling an untreated gas did give off a noticeable fume. Stack-effluent loadings measured only 0.05 gr per cu ft. The cleaned gas burned with a short, bright blue flame.

But now how about the basic blast-furnace-gas furnaces? Since they produced in 1952 some 61,530,000 tons of pig iron against the 630,000 or so tons from the ferromanganese furnaces, their handling seems most important.

...Here's How the J & L Steel Corp Makes Its

Blast-Furnace Gas Yield Rich Iron Ore

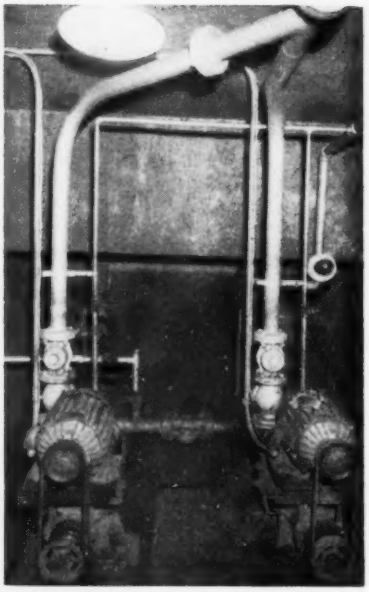
By W A WALTON, *Apparatus Dept, Dravo Corp*

Out of the blast-furnace gas discharged in the process of making 62,000,000 tons of pig iron by the basic method, some 3,000,000 tons of iron ore were recovered last year. Collection and removal of all forms of dust from blast-furnace gas has long been carried out. But only of recent years with the heavy pressure of stream-pollution laws has much attempt been made to recapture the important iron ore in this dust.

Jones & Laughlin Steel Corp recently completed a modern blast-furnace flue-dust-recovery plant for its Aliquippa Works, Aliquippa, Pa. The last word in dust collection, the system not only provides complete recovery of high iron-content dust, but also conforms to the Pennsylvania State Department of Health's Clean Streams Program.

The plant handles a flow of 16,000 gpm of washer water containing about 100 gr per gal of flue dust with an iron content of about 45% (dry basis). The flue dust is removed from the water in special thickeners in a slurry form consisting of about 50% solids. Overflow from these thickeners, with more than 95% of the solids removed, discharges to the Ohio River. The thickened slurry is pumped to a filter house, and then fed to one of two disk-type filters. Here it is filtered and the final cake, pro-

SPECIAL THICKENERS, 105-ft-dia, Walker Process, take up to 16,000 gpm of effluent water from blast-furnace-gas scrubbers, loaded with washed-out flue-dust solids



RUBBER-LINED slurry pumps in tunnels below thickeners remove collected sludge

GAS-SCRUBBER wash water enters the thickeners, *above*, through a center distribution well; clarified water then leaves at surface by way of the two ring weirs

SLUDGE-RAKING ARMS at bottom of thickeners scrape the settled-out solids from the scrubber effluent to the thickener center for their final removal by pumps

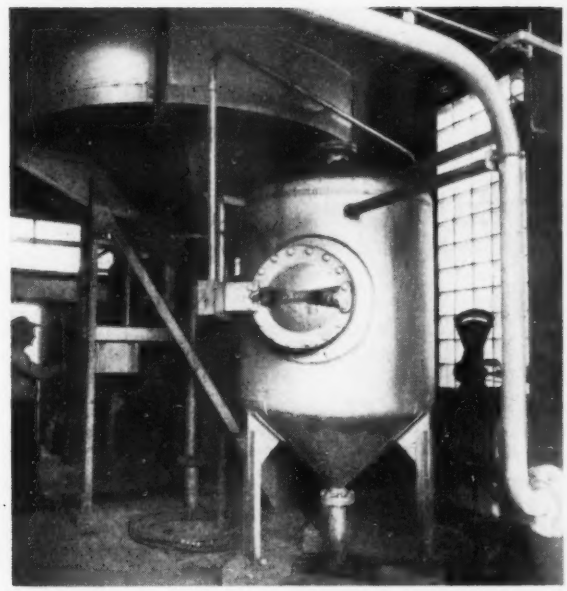
Steel Mills Continued

Water treatment of blast-furnace-gas scrubber output can stop stream pollution

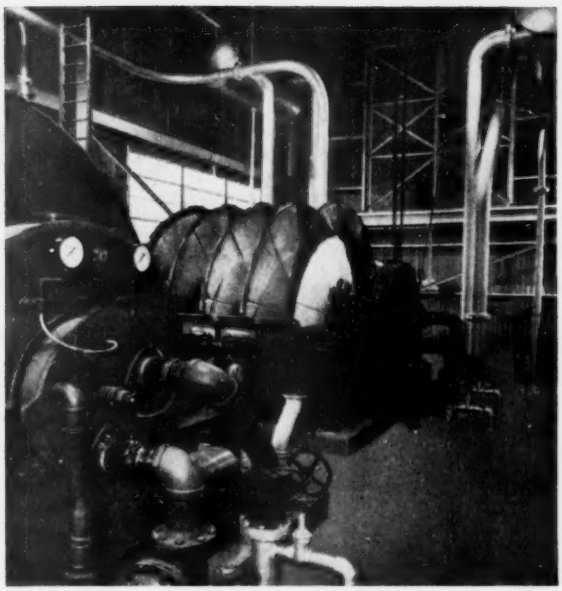
duced at a rate of approximately 65 tons in eight hours (wet basis), goes to a sintering plant with a rated capacity of 100 tons per eight hours.

The original dust-collection system consisted of gravity flow of wash water from the blast-furnace area to a large U-type settling lagoon where a large percentage of the solids settled out before the water overflowed into the plant sewer. This method was expensive in that it required continual clam shelling of the muck from the lagoon and loading it into railroad cars for the trip to the sintering plant, where it was dumped wet with other sintering-plant ore.

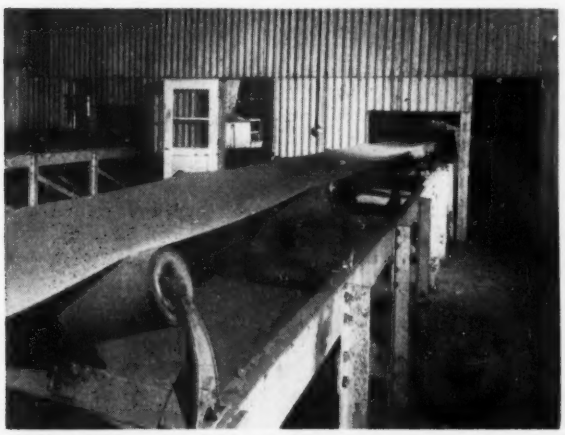
The completely new plant, designed by



OVERHEAD receiver tank gets sludge output from pumps, *left*, and feeds it into one of the two ejector tanks shown above



DISK-TYPE filters receive collected slurry from ejector tanks at about 50% solids concentration and filter it to a cake form



FILTER CAKE, at around 22.5 to 25% moisture content, travels by conveyor to hopper in the 800-ton-per-hr sintering plant

VACUUM PUMPS produce the required vacuum for the disk-type filters shown above; some 1690 cfm each at 20 in. vacuum

Dravo Corp in cooperation with Jones & Laughlin's engineering dept, has two Walker Process *Clariflow* thickeners, photos, left, p 96, sludge-pumping facilities, vacuum filter plant, and dry-cake-handling facilities. The plant utilizes the existing gravity-flow system from the washers at the blast furnace, which eliminates the need of a booster pumping station for handling the dirty water from the washer stage.

Heart of the plant, two 105-ft-dia Walker Process thickeners, handles a 16,000-gpm flow. One important feature is the intake arrangement: Influent enters an annular ring around the large center well and then flows to the center well through multiple tangential diffusion ports that produce a pronounced rotational movement. This diffusion energy causes a circular motion in the large center well, which displaces downward and enters the tank's floor region. Such a radially flowing current, with equal-acting vectors of flow displacement, gives balance and lateral distribution in the tank. Further, it serves to concentrate the solids within the liquid. This denser mass, leaving the bottom of the center well with a circular motion, fans out along the tank floor.

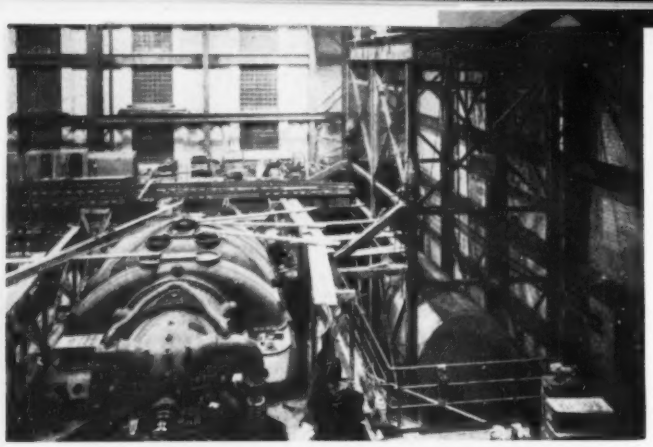
In turn, clarified water—that is, water free of settleable solids—displaced above this strong, moving current, rises upward and flows over into a multiple, balanced overflow weir system. This weir system runs uniformly around the entire surface area of the clarification zone. Velocity of approach to the weirs, though, is low because of the mass of water displaced. The low-velocity level prevents reaching back and drawing up previously settled solids into the weir system. Velocity is so low and uniform, in fact, that previously settled precipitate particles, introduced near the overflow weir, settle back countercurrent to the flow and do not overflow into the weirs to cause any clogging.

Recirculation of previously precipitated solids, by withdrawing them from the sludge hopper and pumping them back to the center well of the thickener,

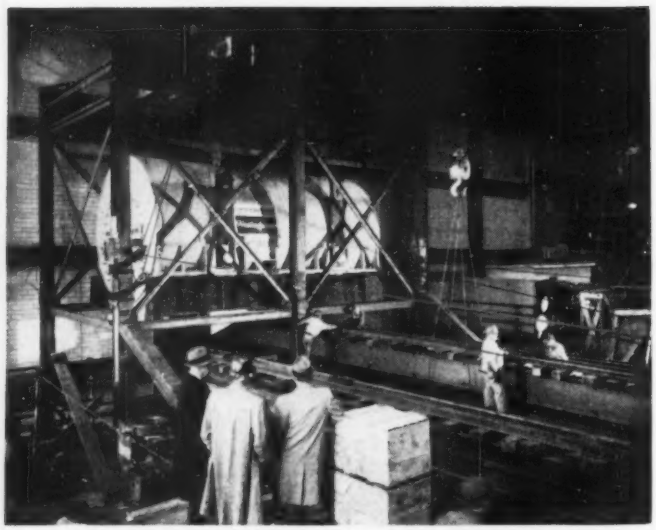
(*Continued on page* 218)

Erection Tower Moves Stator

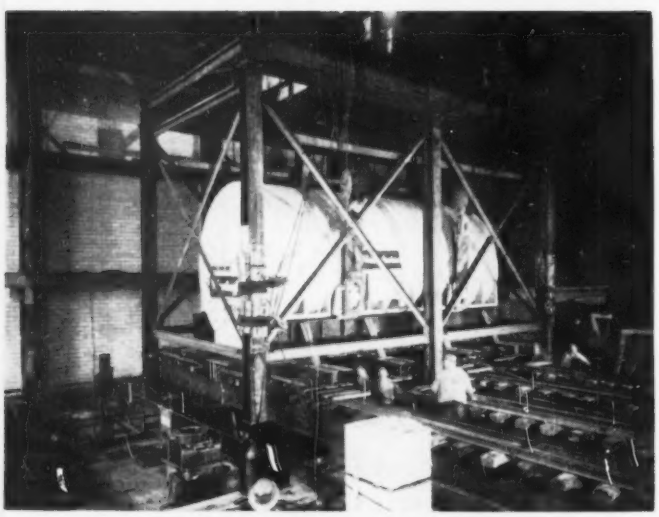
By P M BARNES, *Vice-President*
Eichleay Corporation



125,000-kw turbine in Delaware Station of Philadelphia Electric Co was erected with help of station crane. The 197-ton generator stator, right, could not be lifted by this crane, so special erection tower was designed. The tower, shown at right, in position over the stator resting on railroad flatcar, is powered by three heavy-duty gasoline-engine hoists. First move lifts generator stator vertically up through hatchway above the turbine-room floor.



While tower holds generator stator at a level above floor, riggers place track beams and rails underneath the stator to span open hatchway and provide path to generator foundation, off picture, right. They then attach I-beams to bottom of stator, frame support. These carry weight of stator, transmitting it to rollers riding on the rails. Next step lowers the stator on the rollers, completely unloading the erection tower.

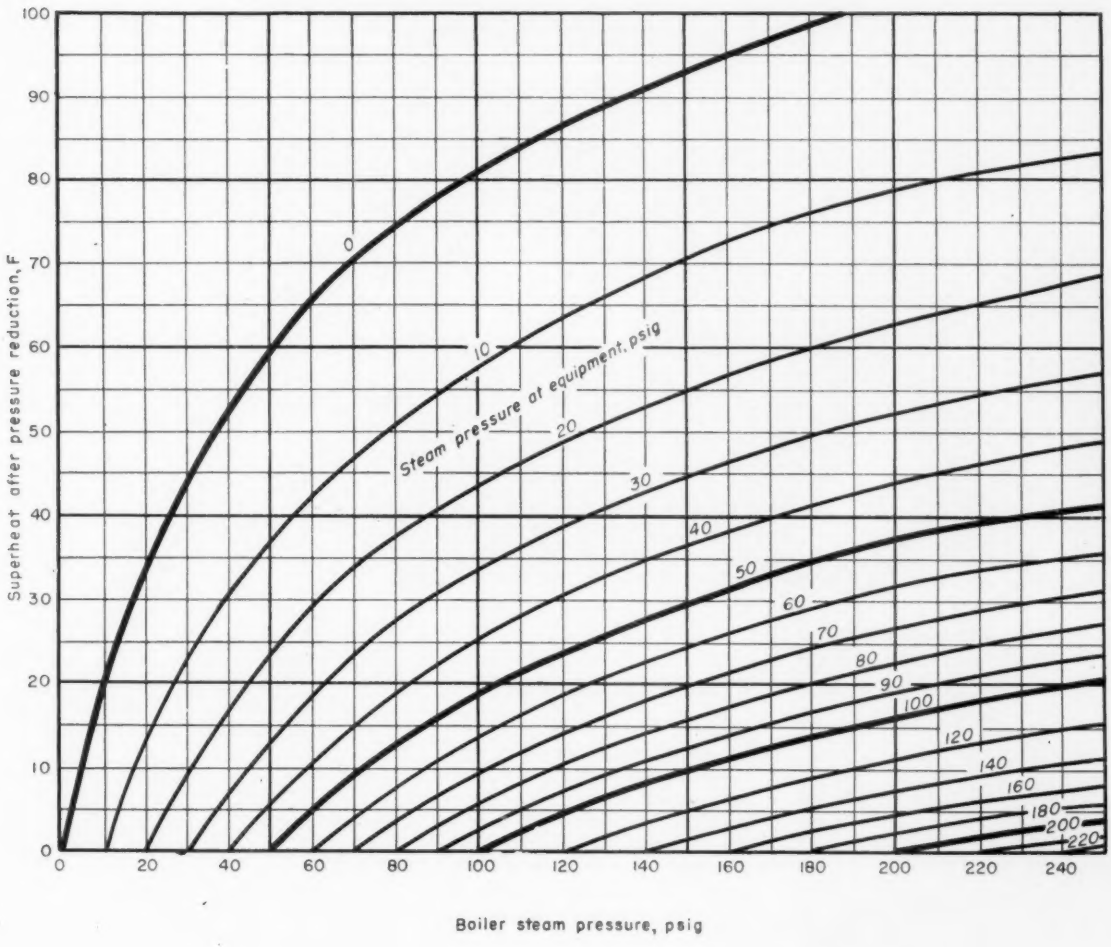


Generator stator is pulled toward its foundation over a distance of about 35 feet. Upper section of the erection tower has been unbolted from the supporting columns, so the station crane, above, can carry it along to remain over the stator. Crane carries tower weight, while rails and track beams carry 197-ton weight of stator. When it is over the foundation bolts, erection tower lifts it off the rollers. All gear is removed, and tower lowers stator into final position.

In final position on foundation, the tower is removed and the stator is ready to receive its rotor. The generator will be driven by triple-tandem-compound turbine with one stage of resuperheating. Steam conditions are 1800 psig, 1000 F at throttle, 1000-F at reheat point.

Power's DATA SHEET

No. 257



Superheat Compensates for Steam-Line Losses

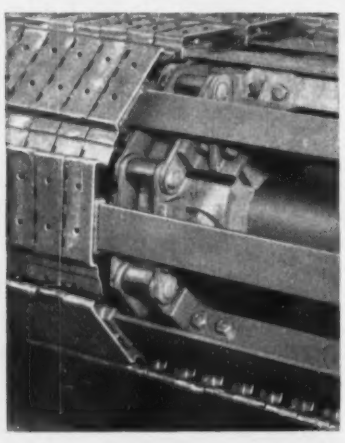
► AFTER PASSING THROUGH long runs of pipelines, saturated steam may contain considerable moisture. This interferes with heat transfer in heating, drying and cooking equipment. The condition may happen even with well-insulated pipelines, properly equipped with drip traps.

One method of delivering dry steam generates it at a pressure higher than finally needed. When throttling to the utilization pressure, the steam becomes superheated. The chart, above, shows the superheat obtainable for steam pressures ranging from 0 to 250 psi gage.

Example: Suppose you need 80-psig steam for your process. You figure that superheated steam would lose about 4½ Btu per lb flowing from boiler to point of use. In this pressure range, steam specific heat runs about ½ Btu per lb. So the steam temperature will drop about 9 F. In the chart, find the intersection of 9-F superheat ordinate with the 80-psig equipment pressure curve. Then read on the horizontal scale, boiler steam pressure slightly under 114 psig. This will deliver dry steam to your heat-consuming apparatus.

BY S D DISTELHORST *Orr & Sembower, Inc*

*Riley Traveling Grate Spreader Stoker Fires 200,000 lbs./hr. Riley Unit at B. F.Goodrich Company Akron, Ohio



GRATE SURFACE

This view of the grate shows the overlapping of special growth resistant alloy clips mounted on structural steel T bars. Note how clips separate to free themselves of ashes and clinkers. Use of small grate clips two inches wide with a six-inch pitch minimizes warping or cracking. Tuyeres in center and at sides of clips provide uniform air distribution.

HYDRAULIC DRIVE

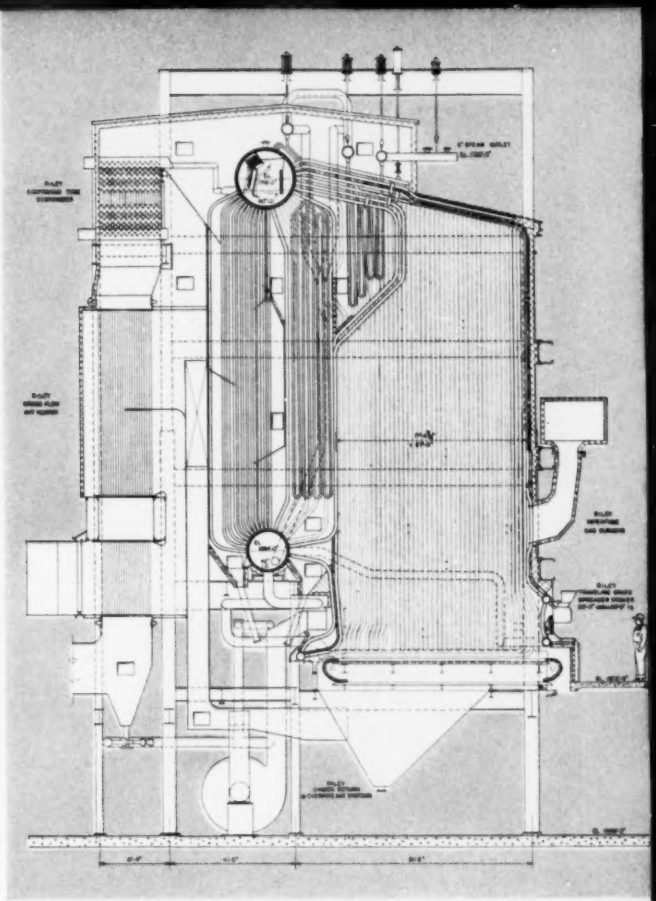
The Riley Grate Drive is a hydraulically driven ratchet drive, completely enclosed and self-lubricated. No sprockets, chains and speed reducers are needed. Hydraulic circuit provides positive overload protection to the grate; Riley Drive provides complete grate speed control from zero to full load. Pressure gauge informs operator of amount of load at all times. Drive operates with low power consumption and with practically no maintenance.

FEEDER DISTRIBUTOR

The Riley Feeder is designed to provide uniform positive feed regardless of coal characteristics and moisture. Avalanching with fine coal does not occur. The Overthrow Distributor provides uniform longitudinal and lateral distribution and prevents damage or outage caused by wedging of foreign materials between distributor and housing.

Here's Proof of **RILEY LEADERSHIP** in the Spreader Stoker field . . .

. . . many leading public utilities and industrials are installing Riley Traveling Grate Spreader Stoker fired boiler units with steam capacities up to 250,000 lbs./hr.!



When large traveling grate spreader stoker-fired steam-generating units are being considered, many leading public utilities and industrials select Riley equipment. They recognize Riley for its extensive experience in the fuel-burning and steam-generating field. They, as most power engineers, prefer the Riley Traveling Grate Spreader Stoker for the superiority of its Riley-developed Hydraulic Drive and Riley Grate surface, the uniformity of its feed and distribution from the Riley overthrowing distributors, its high day-after-day overall efficiency, continuity of operation and low maintenance.

B. F. Goodrich, Champion Paper & Fibre, Kennecott Copper, Gaylord Container, Montana-Dakota Utilities, Utah-Idaho Sugar have all installed large Riley traveling grate stoker-fired steam-generating units. If you are considering high-capacity spreader stoker-fired units, be sure to call in a Riley engineer. It will pay you to do so.

Montana-Dakota Utilities • Mandan, North Dakota
250,000 lbs./hr. Riley Steam Generator
26′ x 20′ Riley Traveling Grate Spreader Stoker

Other Riley Traveling Grate Stoker Installations

Gaylord Container Corp.
Bogalusa, La.
250,000 lbs./hr. Riley Unit
22′ x 20′ Riley Traveling Grate Spreader Stoker

Kennecott Copper Company
McGill, Nev.
235,000 lbs./hr. Riley Unit
28′ x 18′ Riley Traveling Grate Spreader Stoker

Utah-Idaho Sugar Company
Moses Lake, Wash.
250,000 lbs./hr. Riley Unit
28′ x 19′ Riley Traveling Grate Spreader Stoker

Champion Paper & Fibre Company
Canton, N. C.
200,000 lbs./hr. Riley Unit
24′ x 22′ Riley Traveling Grate Spreader Stoker

United States Steel Corp.
General Motors Corp.
General Electric Co.
Celanese Corp. of Amer.
General Time Instr. Co.
Iowa Public Service Co.
City of Hastings, Neb.
City of Springfield, Minn.
John Deere & Co.
Penn. Electric Co.
U. S. Gypsum Co.
Swift & Co.
Ohio Edison Co.
Stokely Foods
City of Ames, Iowa
City of Provo, Utah
Monsanto Chemical Co.
Central Ill. Light Co.
Bendix Aviation Co.
Garlock Packing Co.
Armstrong Cork Co.
Pennsylvania R. R.
City of Napoleon, Ohio
City of Troy, Ohio
Iowa-Illinois Gas & Electric Co.
Corn Belt Power Coop., Iowa
E. I. duPont de Nemours Co.
Minnkota Power Coop., N. D.

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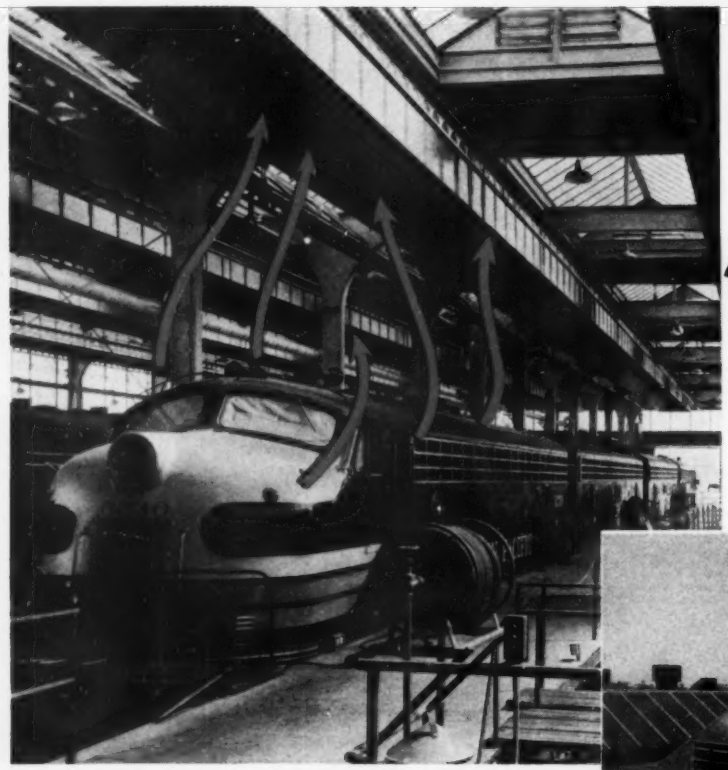
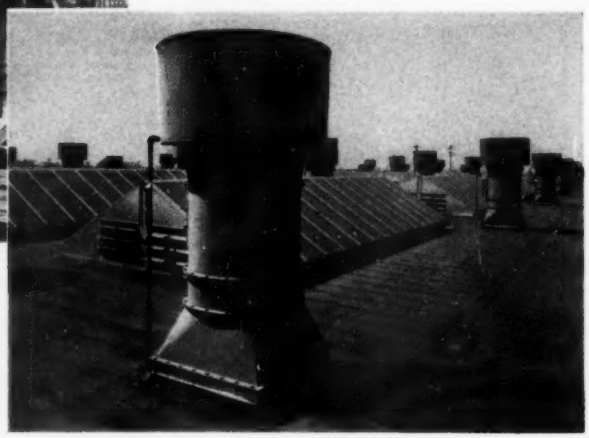


DEODORIZING DIESELS



HOW SOUTHERN PACIFIC VENTILATED ITS ROSEVILLE ROUNDHOUSE WITH JOY AXIVANE® FANS

When in need of servicing, the diesel locomotives of Southern Pacific are driven into the roundhouse and parked under long ceiling hoods. As the engines are raced or idled, the customary acrid fumes and black soot pour from the exhaust. BUT, you have to sniff hard to catch even a faint whiff of diesel fumes in the roundhouse!

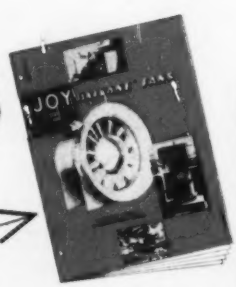
HOW'S IT DONE? By Joy Axivane Fans, of course. Thirty-six fans are hidden in the ceiling hoods. The exhaust gases are hustled out—at the rate of 726,000 CFM—before they can contaminate the surrounding air.

TOPS IN EFFICIENCY. Six 1½ HP models handle 11,000 CFM each, while thirty 5 HP models handle 22,000 CFM each. The fans are actually located right in the exhaust ducts—not an inch of valuable room space is sacrificed!

HIGH-TEMPERATURE PROBLEM, TOO. The air being exhausted is dirty and oil-laden and sometimes reaches a temperature of 280° F. But temperature variation, grease and grime have little effect on these fans. The vaneaxial design, with adjustable blades, packs plenty of punch—under all conditions. The in-line construction and in-the-duct installation . . . possible only with this type of fan . . . make for real space savings.

136 MODELS. The Joy Axivane Fan line is a wide one. Capacities range up to 200,000 CFM and pressures top 11" wg. Some models will nestle in the palm of your hand while others would dwarf your home. Want the whole story? Write for our Bulletin J-611, TODAY. ***Joy Manufacturing Company, Oliver Building, Pittsburgh 22, Pa.,*** In Canada: *Joy Manufacturing Company (Canada) Limited, Galt, Ontario.*

Consult a Joy Engineer, or WRITE FOR THIS BOOKLET #J-611



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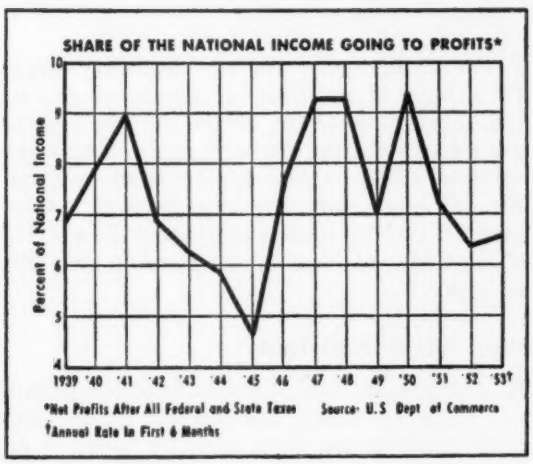
JOY

SPECIALISTS IN THE COMPRESSION AND MOVEMENT OF AIR AND GASES SINCE 1885

The first of two articles on profits

PROFITS...How High Are They?


SHARE OF THE NATIONAL INCOME GOING TO PROFITS*
Percent of National Income
10
9
8
7
6
5
4
1939 '40 '41 '42 '43 '44 '45 46 47 '48 49 '50 '51 '52 '53†
*Net Profits After All Federal and State Taxes
†Annual Rate in First 6 Months
Source: U.S. Dept. of Commerce

How high are profits? What is being done with them? This is the first of two articles designed solely to throw some factual light on these key economic questions.

One of the important economic developments of 1953 has been a substantial increase in the dollar volume of corporation profits from the level of 1952. But to answer the question "How high are profits?" we must also measure them: 1) by comparison with the record of previous years, and 2) as a share of the total national income. The term "profits," as used here, refers to profits *after taxes*. These are the only profits that can be paid to stockholders or retained for use in the business.

In the first six months of 1953, corporate profits *after taxes* were at an annual rate of $20.4 billion. This was higher than in the first half of 1952, but lower than in the full years 1948 or 1950, or in the first half of 1951. If allowance is made for the declining value of the dollar, this year's net profits for all corporations represent less purchasing power than those made five or six years ago.

Here is the record of profits over the years:

	Net Profits After Taxes of All U. S. Corporations	
	Billions of Dollars	
	Actual	In 1953 Prices
1929	8.4	14.6
1939	5.0	9.8
1947	18.5	22.1
1948	20.7	22.7
1949	16.3	18.3
1950	22.7	24.6
1951	20.1	19.7
1952	18.6	18.7
1953*	20.4	20.4

*Annual rate, first six months

The record shows that real profits have a little more than doubled since 1939. This increase, however, does not mean that corporations are doing exceptionally well. The entire national income has doubled since 1939. And our industrial plant is more than twice as large as it was in 1939. Therefore, profits have just about kept pace with industrial growth.

Return on Investment

How high are profits compared with sales, or compared with the stockholders' investment?

What is the rate of return to the people who have invested their savings in corporate business?

The table below shows that for the past three years the rate of return on both sales and investment has been substantially below the return achieved in earlier postwar years. The rate of return on stockholders' investment is higher now than it was in 1939. But this is primarily because today's profits are reported in terms of today's prices, whereas much of the investment in plant facilities is still carried on the books at prewar prices, which are substantially below the cost of replacement. The current rate of return, measured as a percentage of total corporate sales, is below prewar levels.

	Corporate Profits After Taxes	
	Per Cent of Total Sales	Per Cent of Stockholders' Equity *
1929	6.1	NA
1939	4.1	4.0
1947	5.3	
1948	5.3	14.8 average
1949	4.4	
1950	5.3	
1951	4.1	11.8
1952	3.6	10.3
1953#	3.7	10.8

* Manufacturing corporations only
NA Not available
Annual rate, first six months

In considering these figures, it should be remembered that they are averages for all corporations. Some companies make more than the average, and many make no profit at all. In every year since 1915 at least 25% of all corporations have operated at a loss. In 1939, 58% of all corporations were losing money. This year the figure will probably be at least 30%. The improvement since 1939 shows a much healthier economy. But it does not indicate that profits are easy to make.

How Big a Share of the Pie?

The most important single fact about profits is that they now represent a *smaller* share of national income than they have in past years of normal prosperity. For the past three years, profits have taken a smaller share of the pie than in 1939, and considerably smaller than in the early postwar years. Here, as the chart at the beginning shows, is the record:

	Corporate Profits After Taxes as a Percentage of National Income
1929	9.6
1939	6.9
1947	9.3
1948	9.3
1949	7.5
1950	9.4
1951	7.2
1952	6.4
1953*	6.6

*Annual rate, first six months

The main reason for the declining corporate share of national income is, of course, the increasing share taken by the federal government in the form of taxes. The wage earners' share is also higher than in 1939. But the really startling increase is in federal taxes. Taxes on profits now equal almost 8% of the national income, compared to only 2% in 1939.

Why This Is Important

It is important that these facts about profits and taxes be widely understood. At its next session, Congress must consider what to do about the emergency taxes on profits enacted after the outbreak of the Korean War. The so-called excess profits tax is scheduled to die on January 1, 1954. In the absence of new legislation, the rate of the corporate income tax will drop from 52% to 47% on April 1. Many factors, including the revenue needs of the government, must enter into the decision whether or not to reduce taxes. But one fact stands out clearly: By comparison either with past years or with the total national income, corporate profits today are relatively low.

* * *

The second article in this series will discuss what corporations do with their profits.

McGraw-Hill Publishing Company, Inc.

PIPING SYSTEM is discussed by Chief Max Marshall, *right*, with Douglas Huffer, assistant control operator. Textbooks shown have over 600 pages of text—given to each student. *Below*, Charles Chase, plant engineer, instructs electricity class

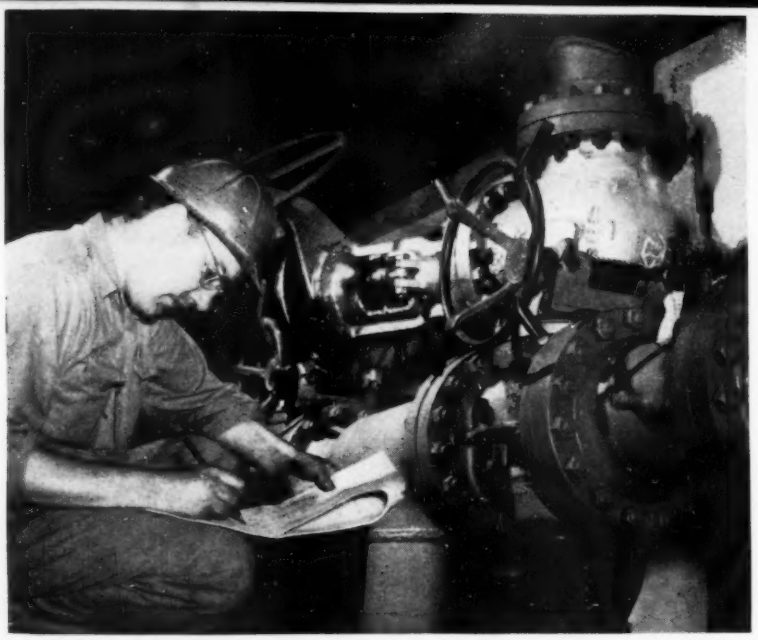
TRAINING OPERATORS...

- ***43-week training program of three one-hour periods a week***
- ***Lessons given on company time, with overtime pay***
- ***Supervisors teach courses***
- ***Former engineering-instructor guides lesson planning***
- ***Total estimated cost of $25,000 proves good investment***
- ***Over 600 pages of text and drawings are given to trainees***

TURN PAGE

Courses boost employe morale because each man knows the plant, and so takes more pride in his work

By **STEVE ELONKA**, *Associate Editor*



TRACING each important piping system with red pencil over simplified print is one of the most important teaching devices. Trainees get to know plant quickly

► LAST NOVEMBER, the new 100,000-kw unit of Glenwood Station, Long Island Lighting Co, Glenwood Landing, Long Island, went into operation without a hitch. Answer is a training program that prepared employes for new duties.

One reason for the program's success is Maxwell Marshall, chief engineer of the plant. His background of preparing lesson plans, teaching classes, at U.S. Merchant Marine Academy during the war, was a big help. Max was so sold on organized lesson plans he was given a large share of seeing training project through. Fact is, it's been tagged "The Marshall Plan" throughout the plant.

Program cost $25,000, but the company feels it is well worth the money. Marshall wrote construction and operation of turbines, boilers, auxiliaries. Electrical course was written by Charles Robbins and Charles Chase. Anthony Tamburrino prepared instrumentation, feedwater treatment.

New Plant. To understand the problem of training present operating and maintenance personnel for the new plant, let's take a look at some equipment and machinery involved.

New reheat boiler has primary output of 750,000 lb per hr at 1525 psi, 1005 F. Reheat steam of 665,000 lb per hr is reheated to 1005 F. Boiler burns coal, oil or natural gas, is semi-outdoor type. Superheat is controlled by bypass damper, and reheat by tilting burners. Oil burners are elevated above coal and gas burners to maintain superheat.

Turbine is tandem-compound, 3-cylinder, 90,000- to 99,000-kw. It has 22 stages and 27 wheels, five extraction points, and is the first outdoor turbine in the Northeast. Entire plant operation is from a central control room.

In the old plant, turbine and boiler operation is local. That plant has six boilers with 2,150,000-lb-per-hr total output at 410 psi, 750 F. Three turbines have total output of 198,000 kw. They are straight-through, single-shell type, with three extraction points.

Six boilers feed steam to common header, which, in turn, supplies steam to turbines. Condensate from turbines passes through stage heaters, then discharges into common feedwater header. These unit-to-unit interconnections can complicate operation.

New plant is first step in a $50,000,000 program, to double firm's electric-generating capacity by 1954. A duplicate unit will go into operation in Far Rockaway this year, and a third at Glenwood Landing, in 1954.

Training Program. Twenty-six operating personnel in plant took this 43-week course, although only 16 men had been selected competitively for the new station; 26 started and 25 finished. The one- to two-hour lectures depended on time needed to put lesson over.

Lessons were scheduled from 8-9 am and 4-5 pm, three days per week, with overtime pay for all attending. Average attendance was 88.9%, which is very high, considering vacations and normal absences. Fact is, many men went during vacations.

All operators were accepted for the course without examinations. Six one-hour exams were given during course; average mark of 82.5% shows that lessons were well-learned.

Chart on opposite page shows how subjects were broken down into lessons. Simple diagrams showing details were blueprinted and every student was given a set. Each man traced out each system by coloring his drawing as he went along. By the time he had traced it, he had located every piece of equipment in that system. This is a great help, for every operator has actually seen each piece of equipment and knows where it is.

Costs. Time to prepare class materiial—research; writing class notes; drawings in textbooks, on blackboards; typing; mimeographing; etc—came to 3590 man-hours. Overtime, chargeable to class attendance, cost $12,000; paper photostats, etc, $670. Cost per student, including supervisory labor, averages about $1000.

Long Island Lighting Co is so well pleased that it is repeating the course for the new Far Rockaway plant.

Not only is each operator better fitted for his job, but these courses have also improved employe morale. As Max Marshall modestly said, "There is nothing to acquaint key men with a new plant like working out lesson plans. By time he gets through assembling the information so it can be taught, instructor learns more than the trainees.

THIS COURSE is wide enough in scope to cover operation and maintenance of all the important equipment in the new plant

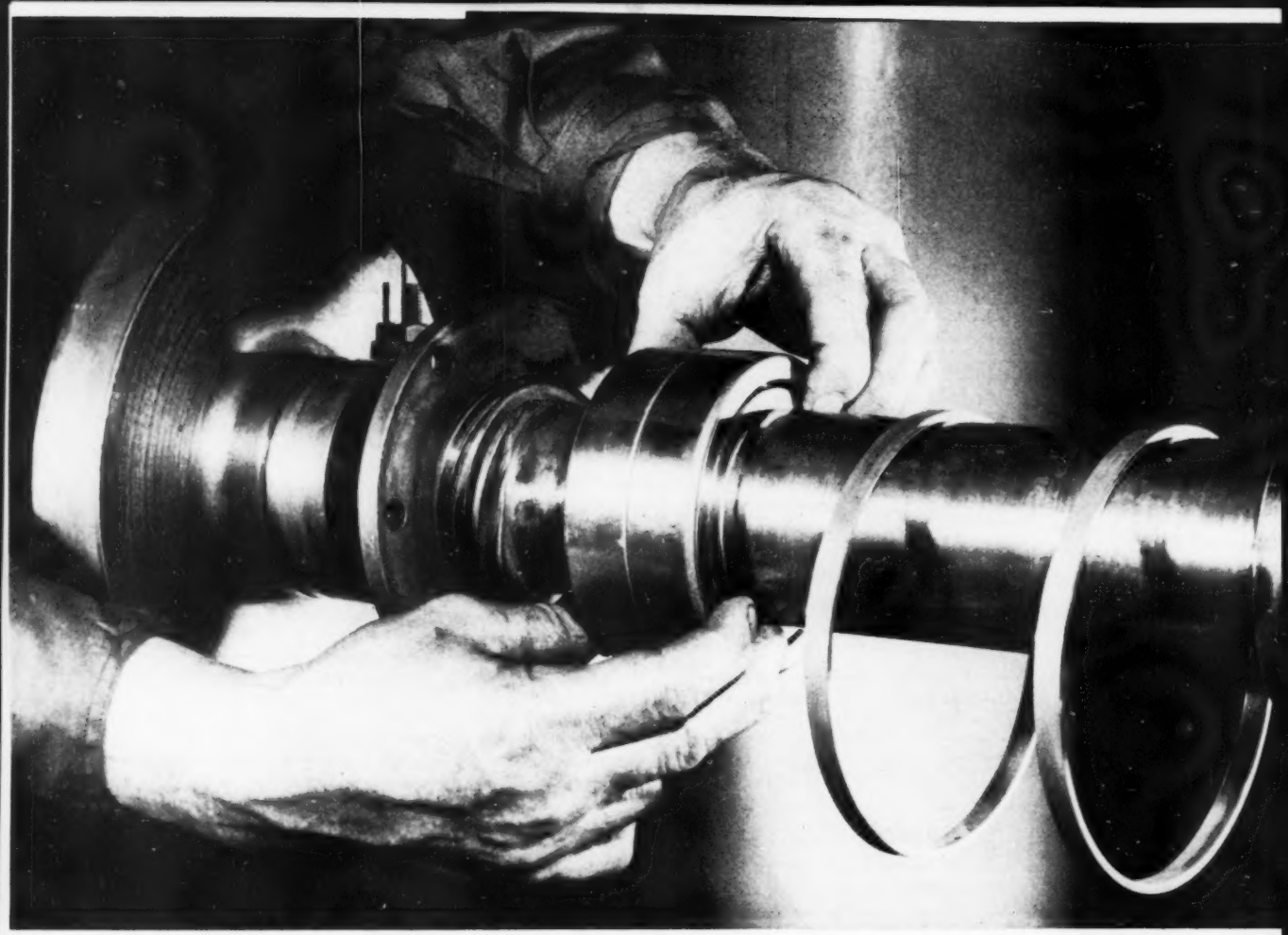
Preliminary Training Program for Station No. 3

First Half of Plan by Weeks

Week	First Period	Second Period	Third Period
1st	**FUNDAMENTALS OF HEAT**		
	1. Introduction 2. General outline of Station No. 3	1. Steam and its properties	1. Simplified steam table
2nd	**STEAM-MAKING FUNDAMENTALS**		
	1. Fundamentals of steam-making and circulation	1. Factors influencing water-tube circulation	1. Warming up a boiler
3rd	**BOILER NO. 40**		
	1. General construction; reheat vs non-reheat	1. General construction	1. Superheaters a. Primary & secondary b. Reheater 2. Superheat control
4th	**BOILER NO. 40**		
	1. Superheaters a. Materials b. Limitations when warming up boiler	1. Economizer	1. Steam-drum internals
5th	**BOILER NO. 40**		
	1. Air heater	1. Air-heater construction, operating procedure	1. Safety valves' construction, location
6th	**BOILER NO. 40 AUXILIARIES**		
	1. I-d fans a. Ductwork	1. F-d fans a. Ductwork 2. PA system	1. Cyclones and precipitators
7th	**BOILER NO. 40 AUXILIARIES**		
	1. Coal-preparation mills – raw-coal system	1. Coal-preparation mills	1. Combustion fundamentals
8th	**BOILER NO. 40 AUXILIARIES**		
	1. Coal burners a. System b. Superheat control	1. Gas burners a. System b. Superheat control	1. Oil burners a. System b. Superheat control
9th	**BOILER NO. 40 AUTOMATIC CONTROLS**		
	1. Hagan controls – Super-master	1. I-d fan – furnace pressure controls	1. F-d fan controls a. Measurement points
10th	**BOILER NO. 40 AUTOMATIC CONTROLS**		
	1. Mill-fan controls	1. Bailey FW control system	1. Report writing
11th	**BASIC FEEDWATER TREATMENT**		
	1. Objectives a. Scale b. Corrosion c. Carryover d. Embrittlement	1. Chemicals	1. Special considerations a. Economizer
12th	**TURBINE NO. 4**		
	1. Construction a. Blading b. Bearing c. Seals	1. Construction a. Bleed points	1. Governor principles
13th	**TURBINE NO. 4**		
	1. Governor construction, features. Basic-speed gov	1. Starting and safety devices	1. Safety and trip devices a. Intercept valve
14th	**TURBINE NO. 4**		
	1. Safety, trip devices a. Stop valve	1. Lubricating system a. Piping b. Coolers c. Purification d. Storage	1. Condenser – construction and operation
15th	**TURBINE NO. 4 AUXILIARIES**		
	1. Air ejectors a. Construction b. Drains	1. Circulators a. Construction b. Capacity c. Priming	1. Condensate pumps a. Construction b. Capacity
16th	**TURBINE NO. 4 AUXILIARIES**		
	1. Boiler feed pumps a. Construction	1. Boiler feed pumps a. Construction b. Control c. Operating precautions	
17th	**TURBINE NO. 4 GENERATOR**		
	1. Hydrogen cooling	1. Hydrogen sealing a. Gas control b. Hydrogen panels	1. Preliminary electrical examination
18th	**BASIC ELECTRICITY**		
	1. Definitions	1. Simple circuits	1. Magnetism and induced voltage
19th	**BASIC ELECTRICITY**		
	1. Dc generators a. Construction	1. Ac theory a. Quantities	1. Ac theory a. Sine waves b. Power factor
20th	**ALTERNATING CURRENT**		
	1. Polyphase circuits	1. Ac generators	1. Transformers and circuit breakers

Second Half of Plan by Weeks

Week	First Period	Second Period	Third Period
1st	**ELECTRICITY**		
	1. Motors' nameplate data	1. Oil circuit breakers	1. Examination
2nd	**ELECTRICITY**		
	1. Wiring diagrams	1. Station control	1. Main control board
3rd	**BOILER NO. 40**		
	1. General review a. Construction b. Circulation	1. General review a. Auxiliaries	1. Main control board a. Boiler section
4th	**BOILER NO. 40 AUXILIARIES**		
	1. Main control board a. Instruments: I	1. Main control board a. Instruments: II	1. Coal-burning system and controls
5th	**BOILER NO. 40 AUXILIARIES**		
	1. Fuel-oil-burning system and controls	1. Gas-burning system and controls	1. I-d fans 2. F-d fans 3. Air preheaters
6th	**BOILER NO. 40 AUXILIARIES**		
	1. Superheat, reheat and feed controls	1. Firing-aisle cubicle	No class
7th	**BOILER NO. 40 AUXILIARIES**		
	1. Ash-handling system and controls	1. Soot-blowing system and controls	1. Chemical feed, blowdown systems; controls
8th	**BOILER NO. 40**		
	1. Interlock protection system	1. Starting-up procedure	1. Banking, removal-from-service procedures
9th	**BOILER NO. 40**		
	1. Boiling-out procedure	1. Report writing, log	No class
10th	**TURBINE NO. 4**		
	Examination	1. General review a. Construction b. Steam flow	No class
11th	**TURBINE NO. 4**		
	1. General review a. Main governor	1. General review a. Pre-emerging gov, stop valve, safety trips	No class
12th	**TURBINE NO. 4**		
	1. Lube-oil system	1. Main control board a. Turbine controls	No class
13th	**TURBINE NO. 4 AUXILIARY SYSTEMS**		
	1. Circulating-water system and controls	1. Condensate storage and transfer system	No class
14th	**TURBINE NO. 4 – GENERATOR**		
	1. Hydrogen cooling and sealing systems	1. Hydrogen system a. Controls	No class
15th	**INSTRUMENTS AND CONTROLS**		
	1. Recorder board	1. Turbine supervisory instruments	No class
16th	**TURBINE NO. 4**		
	1. Starting and operating instructions	1. Testing, shutting-down procedures	Seven-week examination
17th	**ELECTRICITY**		
	1. Generator a. Theory b. Stability	1. Generator a. Theory b. Unit No. 4	1. Exciter a. Field breaker b. Field rheostat
18th	**ELECTRICITY**		
	1. Voltage regulator a. Amplidyne generator	1. Generator leads a. Neutral, surge and potential cubicles	1. Transformers a. Main b. Auxiliary c. Starting
19th	**ELECTRICITY**		
	1. Transformer fire protection 2. Oil circuit breakers 3. Disconnects 4. Potential transformers	1. Relaying a. Station b. Line	1. Field trip a. Switching b. Elec layout
20th	**HEAT BALANCE**		
	1. Turbine condensate cycle	1. Low-pressure heater	1. Low-intermediate pressure heater
21st	**HEAT BALANCE**		
	1. High-intermediate press. heater	1. High-pressure and cross-over heaters	No class
22nd	**HEAT BALANCE**		
	1. Evaporator	1. Closed cooling-water, gland-sealing systems	1. Turbine heat-balance auxiliaries a. Controls
23rd	**MISCELLANEOUS**		
	1. Lube-oil purification system	Examination	Graduation



SKILLED HANDS and trade judgment come with a true love of machinery and years of experience. This machine should give

Let's Inspect and Overhaul Your Steam

By **STEVE ELONKA**, *Associate Editor*

► TURBINES ARE STURDY, need little attention. But you must open them for a general check-up every so often, depending on service and operating conditions.

When John Wolf, chief engineer of F M Schaefer Brewing Co in Brooklyn, N. Y., told me he had his small turbine open, I scooted right over with our photographer Kriss Grube. It isn't often that an editor and a turbine can get together during general overhauls. Then John Nussbaum, the plant's first assistant engineer, and Arthur Stamper, assistant engineer, saw that I got the photos I wanted.

Check-Up. A machine running at constant load with few shutdowns need not be opened as often as one on start-and-stop operation. That kind of service causes high-temperature stresses from quick-starting, sudden load changes.

If you're not prepared to do the job yourself, be sure to have turbine firm supervise this important work. An experienced man will know what telltale signs to look for and how to correct them so machine won't have to be opened again until next scheduled shutdown.

Bearings. Turbine shown has ball-bearing thrust. Most operators find it good insurance to remove thrust and replace with new every time turbine opening is scheduled, regardless of wear. Reason is that thrust bearing's failure can wreck internal parts by rubbing them against each other.

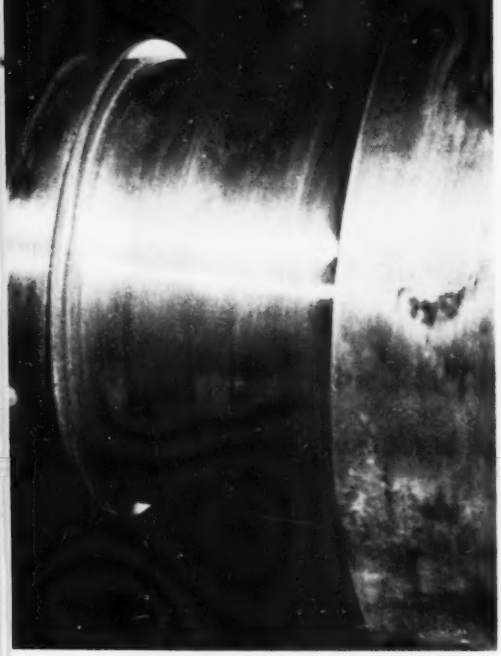
Flexible Coupling. If you have this type of coupling, dismantle and check for wear, shoulders and galled surfaces. If coupling does not work right, it may transmit thrust from connected machine to thrust bearing. Then overloading may cause failure. Replace worn parts, clean and assemble coupling.

Right way to check clearance between split bearing and journal is with inside and outside micrometers. Mike shaft with outside micrometers, then mike assembled bearing with inside mikes at various points. Take the difference, and that's the clearance.

Rotor, Stationary Elements. Turbine's efficiency depends on high-velocity steam. So slightest internal defect can be costly. First, keep steam clean so there is no deposit on blades. Soluble deposits usually form at earlier turbine stages, insoluble deposits on middle and later stages. Whatever kind, deposit restricts steam flow, cuts efficiency.

Remove deposits, inspect moving and stationary blades carefully for erosion, corrosion and cracks. Cracks form around blades and spread out from

OPERATORS' NOTEBOOK 69



good service because it's in good hands

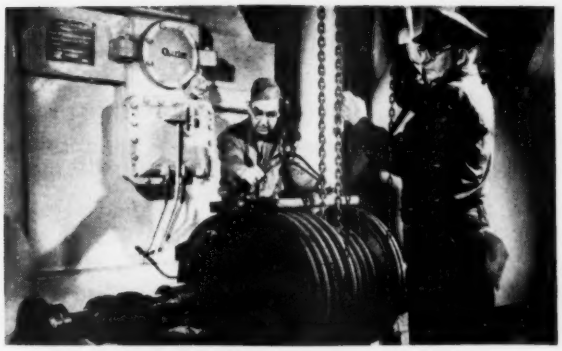
Turbine Now

the jacking-holes in the turbine rotors.

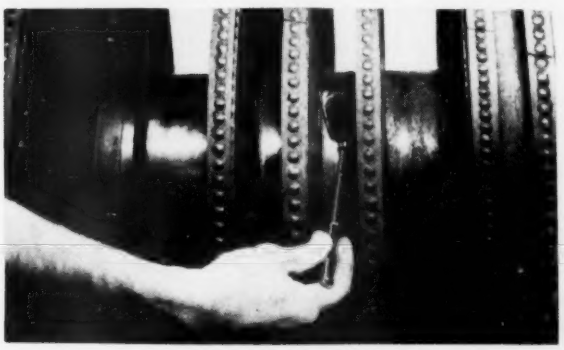
Corrosion can be serious if valves don't seat properly in sealing, drain, throttle and header valves during idle periods. Then steam condenses in turbine, doing damage. Answer is to regrind valves and keep them tight.

It's good practice to indicate rims of turbine wheels while machine is open. Reason is that years of operation and temperature changes cause growth and distort turbine casing, rotor and stationary elements. Turn rotor slowly while indicating wheel rims. Also, take clearances between each wheel at rim —check with previous figures.

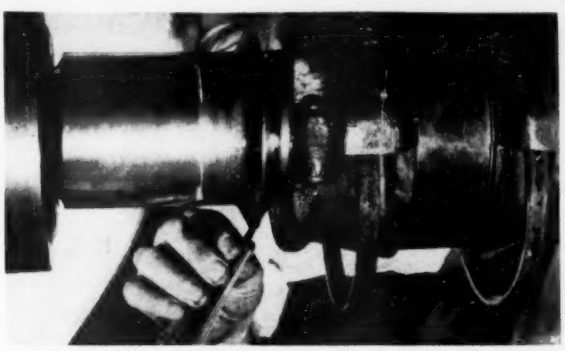
Safety. Don't take chances. Use right lifting gear and tools. Have only responsible men on job. Clean all parts thoroughly and remove dirt with vacuum hose. Check everything yourself to make sure no slipup increases outage.



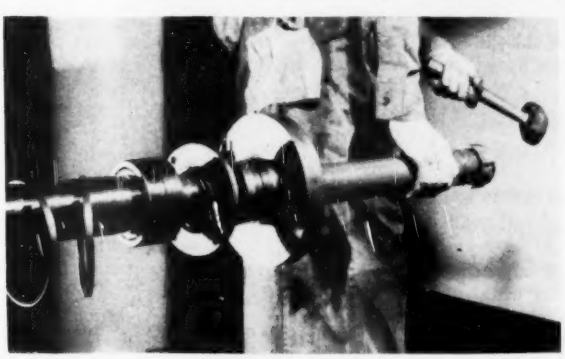
OPEN TURBINE CASING, remove rotor. In photo, hardwood spacer slab prevents sling's wire cables damaging the blades



INSPECT wheel jacking-holes for cracks; all moving and stationary blades and nozzles, for cracks, erosion, corrosion



QUICK clearance check of main bearings without taking leads is to use feelers as shown before taking bearing off shaft



DRIVE new thrust bearings on shaft if old are worn. It's good insurance to install new ball-thrust at each overhaul

Delegate to each man the work he knows best so machine is put back in operation in the least possible time

NUMBER all stationary diaphragms so they go back in right places. Clean blades thoroughly, then inspect for erosion. Inspect garter spring carbon-ring grooves

RETAP all threaded holes so screws enter easily when parts are assembled

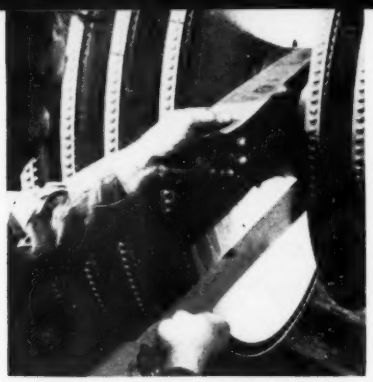
SCRAPE bearings if they need it. Here carbonized oil is removed in dust form

CARBON RINGS are used here for both interstage and casing-end sealing. Rings are made in segments, held together with garter springs, and kept from turning by metal stop on spring. These rings work like piston rings—sealing against shaft and side of groove they are housed in.

Clearance between shaft and ring must be right. Keep to turbine maker's recommendations. Before checking clearance, polish shaft section that rings seal, so surface is right. If too much clearance, polish ends of segments with fine abrasive cloth. But this job must be done right or ring ends will leak steam.

If there is much refitting, best practice is to turn piece of short stock same diameter as shaft and use it on work bench to fit rings onto. Carbon dust or solids from boiler carryover often cock rings in groove, causing them to break. Or impurities work into segment ends, causing leakage.

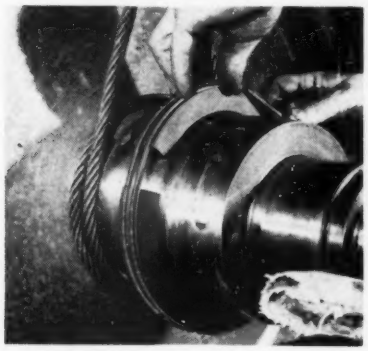
Usually, you have only to clean carbon dust from sides and ends of ring, clean sides of grooves and reassemble rings around shaft. Rings are precision made, so give job to good mechanics.



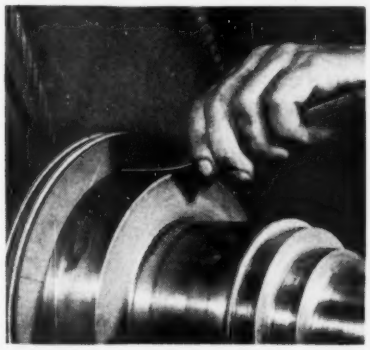
POLISH shaft sections with a fine abrasive strip where the carbon rings seal

RUB the ends of carbon rings lightly against fine abrasive cloth to clean them

Carbon seals prevent leakage between the various stages



ASSEMBLE the ring segments on shaft and hold together with garter springs

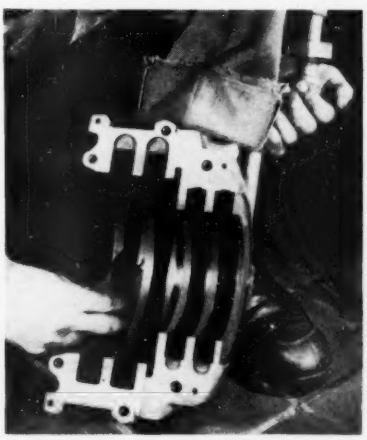


CHECK clearance against manufacturer's recommendation. Sand ring ends if needed

Right clearances do better sealing job, save shaft

LABEL all segments so they go back into the right places, to avoid trouble

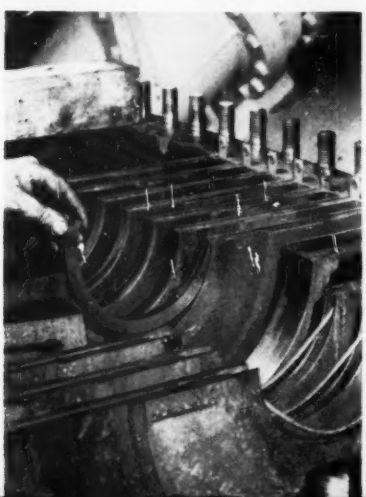
REPLACE ring segments in stationary diaphragms after cleaning with vacuum



CLEAN groove sides of carbon-ring housing as sides are also the sealing surfaces

SMEAR sealing compound in turbine housing to seal the lower half of gland box

Carbon rings seal against groove side and shaft, like piston ring

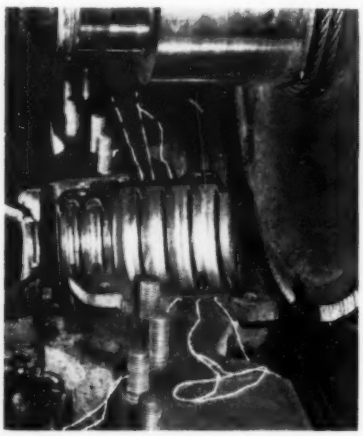


High - pressure steam leaks under carbon-ring housing if it's not sealed

Turn page

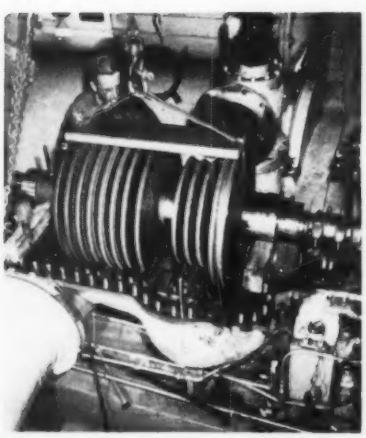
Use vacuum cleaner to remove all dust and foreign particles. Machine's inside must be kept clean

PLACE three strips of light condenser cord on sealing compound as shown here



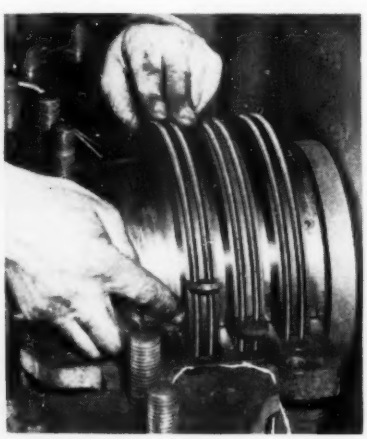
LOWER half of carbon-ring casing is in place here and sealed against h-p steam

REPLACE soft packing at housing end that keeps oil from traveling on shaft



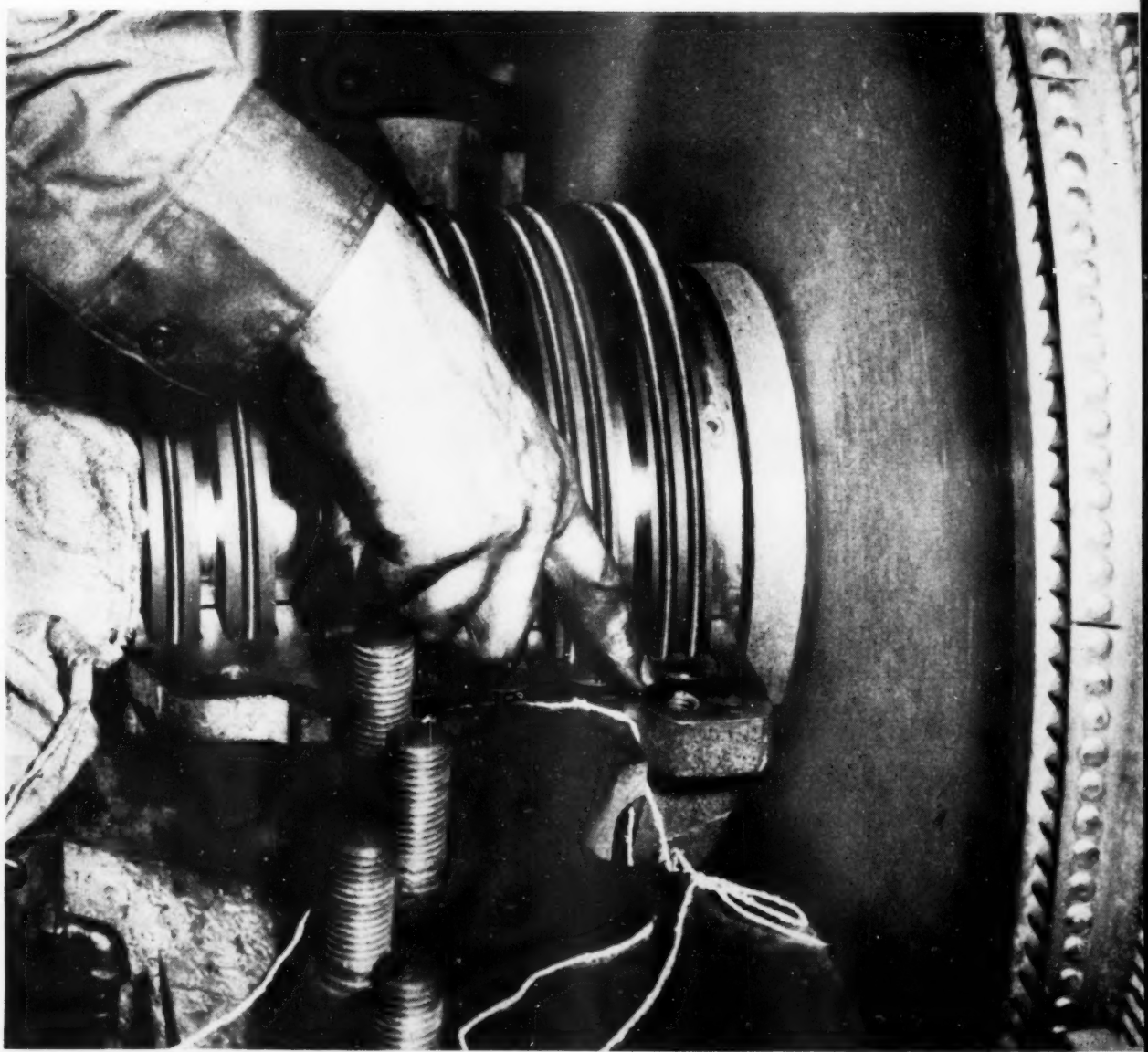
LOWER rotor assembly into place after removing the wooden blocks and the tools

WITH rotor in place, insert the garter springs in groove, fasten around the shaft



METAL stops prevent carbon rings turning. Move rings so the stops fit in slots

Sealing compound and asbestos string recommended by maker are the best



WHEN RINGS are all assembled, move metal stops down into position before closing up the carbon-ring casing. Rub light coating of sealing compound on casing joint, but be careful not to smear on the carbon rings or on the garter springs

Turn page

Careful work, with every man doing his job right until machine is "buttoned up," will keep this unit running many months until the next major overhaul

PLACE top half of carbon-ring casing carefully in place over coated joint

POSITION carbon-ring segments into the diaphragms against the spring as shown

COAT diaphragm's joint face with graphite and cylinder oil before lowering in place

DIAPHRAGMS are all in place between these moving blades

CLOSING the turbine means an anxious period because many things can go wrong to cause delay. From around casing, clear all tools and small parts that might fall in, making you lift cover again—or, worse yet, that might go unnoticed until turbine is turned over with steam. That's why you should use only responsible mechanics.

Before spreading sealing compound on casing joint, again vacuum the joint surface so tiny foreign particles dropping on joint will be removed, instead of shoved inside. Compound used here on joint is Copaltite. Apply only when casing is ready to be lowered after asbestos string is placed as shown. On very large turbines, compound is usually applied with a short, stiff paint brush. Here, it was spread thin by hand to cover surfaces evenly and without smearing on

Use cylinder oil and graphite sparingly or it will end up in the boilers

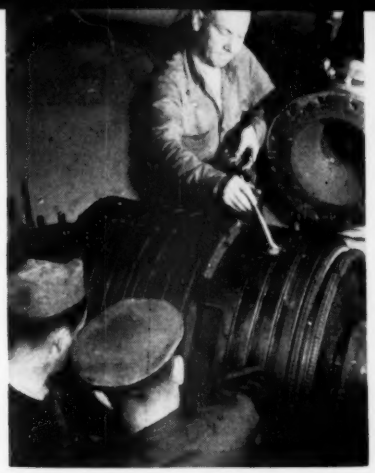
HEALTHY SMACK against wood block helps seat diaphragms

the other parts, such as studs, carbon rings, rotors, etc.

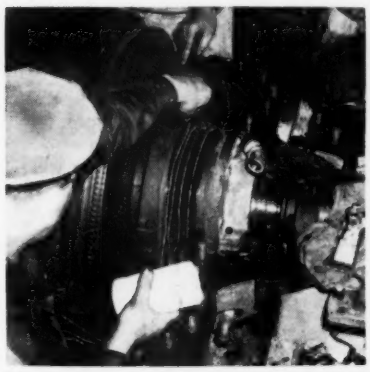
Asbestos twine gives body to compound, and makes a triple seal for steam to work through if there are low spots in the joint surface.

After casing is lowered, take up on all nuts evenly, only hand-tight. Then tighten nuts by staggering from one side of the casing to the other, instead of starting with one nut and going all around.

Scheduled maintenance, as shown in these photos, is the only answer to preventive maintenance. But, again, I should remind you that unless you are set up to do the work, it will pay to have one of the manufacturer's field engineers supervise the job. Before opening a turbine, always have on hand spare parts that might be needed—in good shape.



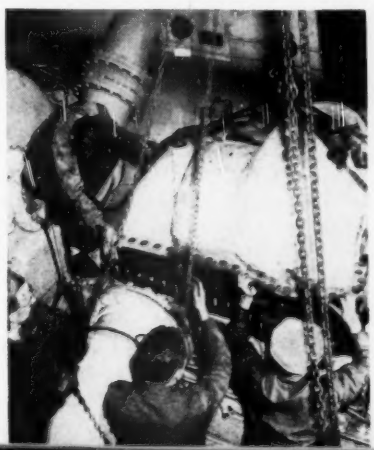
COAT outside of all diaphragms with graphite and cylinder oil as shown here

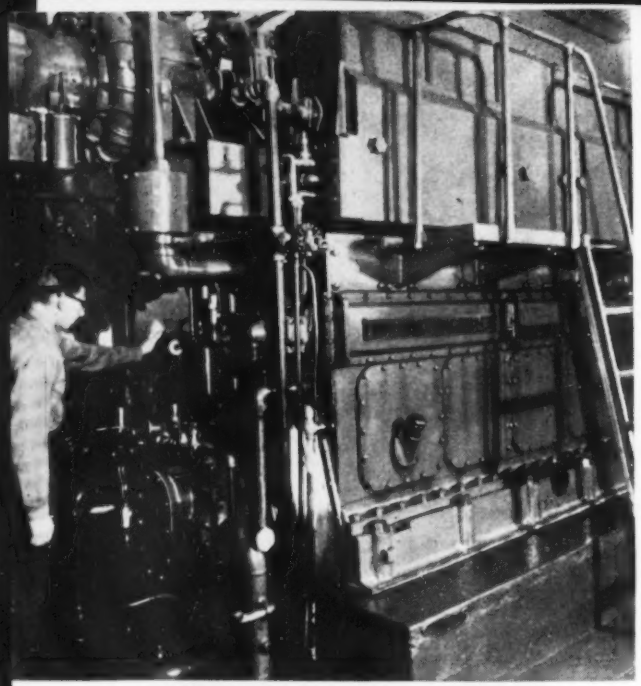


RUN this fine asbestos string, three turns, all around the coated casing

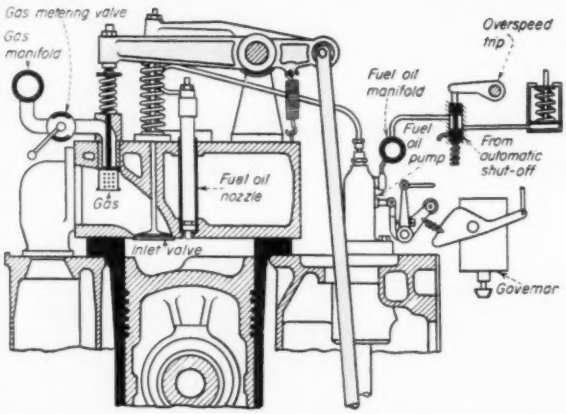
CASING joint is well-coated with sealing compound—asbestos string placed

"LOWER AWAY, and here's smooth sailing because this turbine is shipshape"





FULL-DIESEL dual-fuel unit, compression spark-Ignition gas



THE GAS is drawn into cylinder through inlet valve, while amount of gas is controlled by metering valve in this engine

Dual-Fuel Maintenance

By **C MORGAN JONES**, *Diesel Engineer*

► BOTH GAS-ENGINE and diesel men often regard the dual-fuel engine as something of a mystery. But, while different, it actually calls for no specialized maintenance know-how or operating ability. There are some equipment parts on a dual-fuel engine not found on the full diesel, though. These are commonplace on the full gas engine.

Scrubber. First of these extras is the gas scrubber, between the gas main, supplying the plant and the engine. If gas is corrosive, scrubbers remove troublemakers, which greatly extends liner, piston and valve life. Fit two scrubbers so you can clean one while the other takes load. If only one is used, operate engine as a full diesel while changing or cleaning scrubber.

Reducers. Next are the gas pressure-reducers. You must always use these even when gas pressure is low, as they maintain the right pressure. When gas pressure is high, I've found that two reducers give better gas-pressure control. Reduced gas passes to receiver.

Receiver pressure is important and receiver's capacity depends on engine size. A good receiver capacity-formula is to allow 0.02 cu ft of capacity for each 1000 Btu contained in a cubic foot of gas. Multiply answer by engine's full-load horsepower. If gas value is only 500 Btu, receiver capacity must be doubled. So if engine is rated 1000 hp and gas value is only 500 Btu, receiver capacity will be 40 cu ft.

From receiver, gas passes to engine's gas manifold. Manifold pressure is important. For supercharged engines, a manifold pressure of 19 to 20 psi is best, but exact pressure depends on engine itself. Rarely will two engines burning the same fuel give identical performances under similar conditions. Instead, I find that trial and error often decide best operating pressure.

For nonsupercharged engines, gas pressure can be anywhere between three and seven inches of water. But, again, best operating figure depends on engine and gas quality.

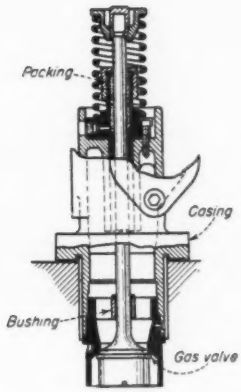
Gas hookups for units, both small (about 150 hp) and large (to 3000 hp and more), are shown in sketch (right, facing page).

Metering Valve. Gas next passes to the metering valve. This valve (sketch, center on facing page) is operated through a fuel-gas control shaft, operated in turn by governor linkage. These valves are important. They can be individually adjusted for required gas flow to each cylinder.

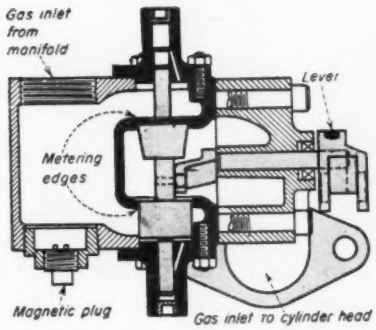
When engine is running, compare exhaust temperatures. If there's a difference of more than 50 F at full load, adjust metering valves until exhaust temperatures are balanced and within 50 F of each other. It's usually best to reduce high temperatures instead of bringing all readings up to high figure. Reduce unless they are well below maximum figure recommended for engine when running at full load. If below, admit more gas to low reading cylinder to increase exhaust temperatures.

Pay careful attention to timing of gas-injection valve. This valve admits metered gas into engine's air intake-manifold. Sketch above shows position.

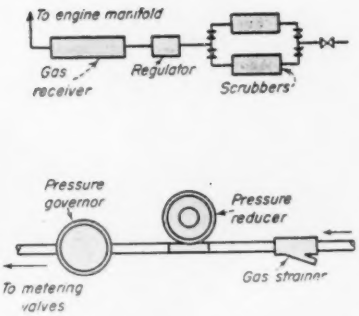
Don't open gas injection-valve while exhaust valve is open. In all modern engines, exhaust, air-inlet valves are both open briefly as piston passes through top center, at end of exhaust, and beginning of air-inlet stroke. Injection valve opens the instant exhaust valve closes. If gas injection-valve opens



GAS injection valve must work freely. Make sure bushing does not bind stem



GAS metering valve of dual-fuel unit is actuated by the lever at the right



GAS-MAIN hookup for large engine is at top, for small engine at bottom

Gases Burned in Dual-Fuel Engines and Their Values

Gas	High heat value Btu per cu ft	Cu ft air needed to burn 1 cu ft	Btu value per cu ft of mixture
Carbureted water gas	578	4.85	98.8
Coal gas	634	5.50	97.7
Coke-oven gas	536	4.65	94.8
Natural gas	1125	10.84	94.8
Blue-water gas	310	2.28	94.5
Oil gas	516	4.25	93.2
Sewage gas	652	6.21	90.5
Producer gas	136	1.08	65.3
Blast-furnace gas	93	0.70	54.7

before exhaust valve is closed, gas will pass across combustion space and out of engine into exhaust manifold, where it may burn in exhaust lines or silencer.

Injection valves are often operated by their own individual camshaft, or by an additional cam on main camshaft. If camshaft is correctly timed, then valves must also be correctly timed, so only adjustment needed is at valve tappets. Sketch (left, above) shows one type of gas injection-valve.

One make of dual-fuel engine operates on high-pressure gas. Gas enters compressor from scrubbers and is delivered to cylinder-head valve at about 1100 psi. Compressor is engine mounted or independently powered. Gas is held in a receiver for delivery to engine.

Valves run hotter on most dual-fuel engines than on full diesels. Often, you may have to make slight tappet adjustments besides those manufacturer recommends for best operating results.

If one cylinder continually detonates, retard its fuel-oil pump timing from one to three degrees. This should help unless its cause is something unusual, such as increased compression ratio for that cylinder.

Always carry cooling-water temperatures as high as manufacturer allows.

When engine runs on full oil and gas mixture (with plenty of gas) but gradually moves into oil operating range so percentage of oil burned slowly increases, check gas pressure at main and at receiver. Trouble may be dirty gas strainer or cleaner, or defective gas regulators.

Governor linkage needs accurate adjustment. Always check gas metering-valve and fuel-injection pump linkages. Make sure distances between linkage-pin centers are correct at every overhaul. These dimensions can affect metering of oil fuel and gas. If engine "hunts" (speed varies at constant throttle setting) inspect linkage for binding and, if a long time has elapsed since last overhaul, for wear.

Trouble shooting in dual-fuel engines. Let's say engine is running on oil, and control lever or wheel is turned to the gas position. If engine loses speed, line valves in gas hookup may be closed or only partly opened.

If engine fails to pick up speed when running on gas-and-diesel fuel mixture, check the gas metering-valves. They may be improperly set. Faulty setting of valve can also lead to "hunting."

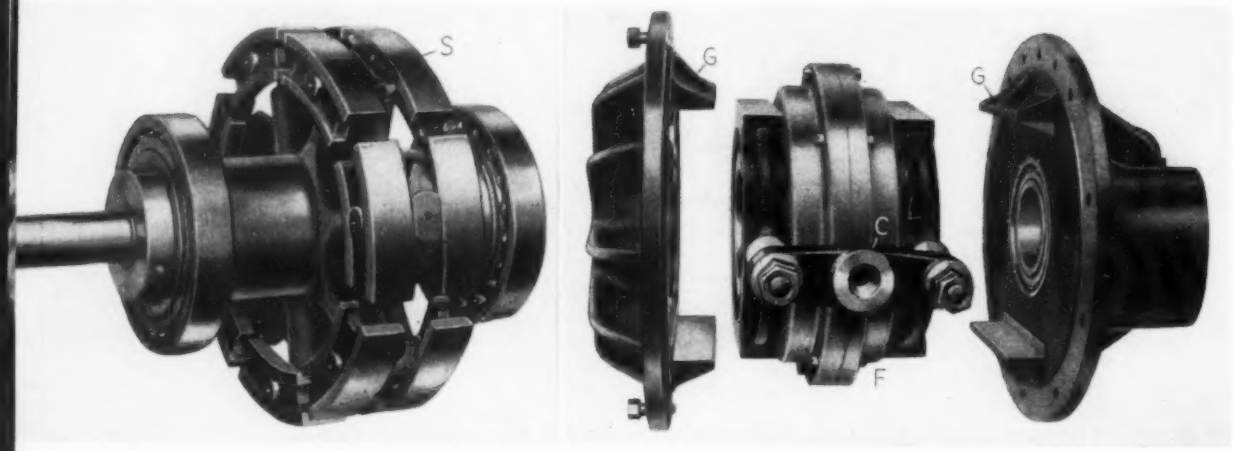
If engine knocks when running on diesel fuel, and gas injection of "pilot" fuel is taking place too early, retard injection. Clearance of gas injection-valves may be too little, or injection valve may be leaking. Often valve packing is too tight and needs slackening back to allow valve to move freely and admit full quantity of gas to cylinder. Knocking can also be from unbalanced cylinders.

If engine starts but runs erratically when placed on gas fuel, check for: (1) low gas-fuel pressure (2) defective gas regulators (3) incorrectly adjusted gas throttle (4) incorrect gas-injection-valve clearance.

Should engine misfire in exhaust manifold, pilot fuel-injection is taking place too late.

If pyrometer readings show temperatures are too high in all cylinders, check for late injection of pilot oil.

If temperature is high in one cylinder only, trouble is often due to injection valve sticking because valve-stem packing is too tight. Check stem for grooves.



1 *Left,* assembly of cylinder body, pistons and slippers for the pump in Fig. 2. *Right,* cylinder and the piston assembly is enclosed in the floating ring *F,* which rides on the guides G in the pump end covers. The control connects to the unit at C

Rotary-Piston Pumps: How They Can Do a Job in Your Plant Today

How to use variable-displacement pumps for many jobs in your plant was discussed in September by Fred Annett, Contributing Editor. Now he follows with details of other pump designs that can be a big help when you have knotty pumping problems

► ROTARY-PISTON PUMPS are built in several designs for variable-displacement service. They can be divided into two general classes (1) parallel-piston (2) radial-piston. The first named was covered in September pp 112, 113.

Radial Piston. Pumps of this type, Fig. 3, have a number of radial cylinders, *B,* that rotate with their positions, *P,* about central cylindrical valve *V.* This valve forms a fixed center about which the cylinder body can rotate. Piston-assembly position is adjustable so its rotation center can be changed relative to the cylinder body to control pump discharge.

In Fig. 3A, pistons *P* and floating ring *R* are concentric with cylindrical valve *V.* When they are in this position, rotating them and the cylinder body about the valve does not cause any motion of the pistons in the cylinders. As a result, there is no pumping action. Moving the floating ring, which carries the piston, off center with the cylinder body and valve, Fig. 3B, causes the pump to discharge.

Assume clockwise rotation. Then pistons above the horizontal diameter move into the cylinders and discharge through the two top ports in the valve. Below the horizontal diameter the pistons are pulled out of their cylinders and fluid flows into them. That is, pistons in the pump's bottom half are on suction, while those in the top half are discharging.

Reverse Pumping. Moving the floating ring with its piston assembly, so that its rotation center is to the right of central valve *V,* reverses pump operation. With the same rotation direction, pistons above the horizontal diameter are pulled out of their cylinders and are on suction. Below the horizotal center line, the pistons move toward valve *V* and are on their discharge stroke.

Amount of eccentricity of pistons and floating-ring assembly with respect to the cylinder body and valve *V* determines pump's stroke length and discharge volume. The stroke length can be controlled in infinitely small steps from zero to maximum.

Pump Construction. Fig. 2 shows a horizontal cross section through a variable-displacement pump of the type in Fig. 3. Cylindrical valve *V* has four holes parallel to its axis. Two of these connect with intake ports and two with discharge ports at each end of the valve. The left-hand cover of the pump rigidly supports valve *V,* and the ports connect to suction and discharge *O* and O_1. Either opening may act as suction or discharge, depending on the pistons' rotation center relative to that of the cylinder body, as explained above.

Ball bearings *B* and B_1 in the pump end covers support the cylinder body

and hold it in a fixed position relative to the central cylindrical valve. Bearings D and D_1 support the pistons and their floating ring, which can be moved sidewise on guide rods R. Clearance C around the cylinder support permits displacing the pistons' rotation center from that of the cylinder assembly, which is fixed by the drive shaft. When the driving motor turns this shaft, the cylinder body, pistons and enclosing case E turn with it to make the pump function, as explained in Fig. 3.

Fig. 1 shows an assembly of the cylinder body and its pistons with their slippers, S. The assembly is enclosed in the floating ring F, Fig. 1. End covers at each end of the floating ring carry guides G, between which ring R is supported and can be moved horizontally by the control connected at C.

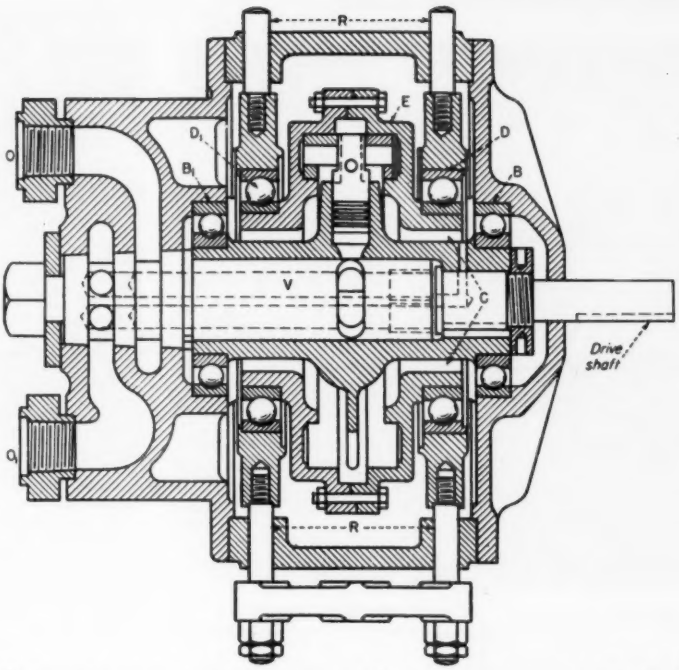
There are several designs of radial-piston pumps, but they all operate on the principle described in Fig. 1 to 3. However, they differ in mechanical details such as the type of bearings, valve arrangement and where the piston thrust is taken. In some designs, curved shoes or slippers take the thrust; in others, anti-friction rollers are used.

Self-Unloading Pumps. Discharge of these units is practically constant at any setting of the control. If the delivery line is suddenly closed, discharge pressure rises until a relief valve opens and bypasses the fluid back to the suction reservoir. The pump, Fig. 4, unloads by swinging the rotor to a neutral position if discharge pressure rises above a fixed value. In this pump, pistons P ride on slippers L against a stationary ring R. Cylinder block B rotates about a central valve, V, as in Fig. 3, but the valve in this pump has only two ports; that in Fig. 3 has four.

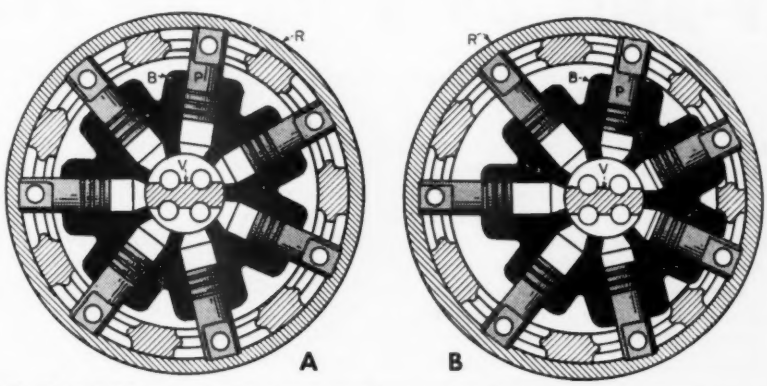
A screw head, H, on the side of ring R contacts a knife edge on block K. Laminated-steel spring S, held between block K and a lip on ring R, holds the ring in an eccentric position, as in Fig. 4A. With the ring held against the left side of the casing, clockwise rotation of the shaft puts the pistons below the horizontal diameter on suction and those above on discharge. Screw head H in contact with the knife edge is a rotation center for movement of ring R.

If the control valve in the discharge line is closed so the pump cannot deliver, pressure increases in the pump to where ring R with its pistons moves to the right to the neutral or zero-discharge position, Fig. 4B. In this position the ring and pistons are concentric with the central valve and the pistons do not move in their cylinders. As long as the control valve is closed, the pump remains unloaded. When the valve is

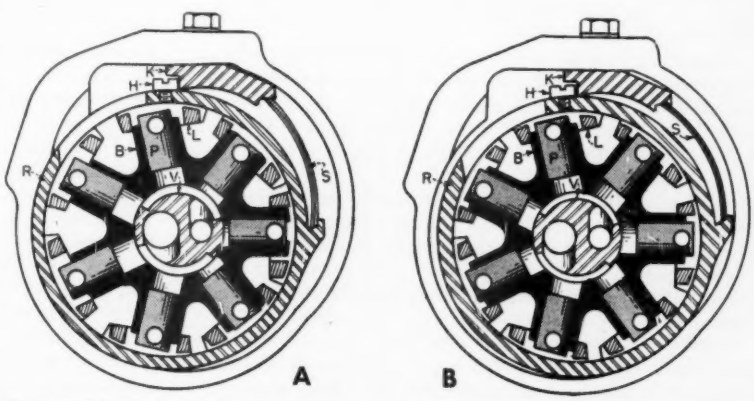
(*Continued on page 224*)



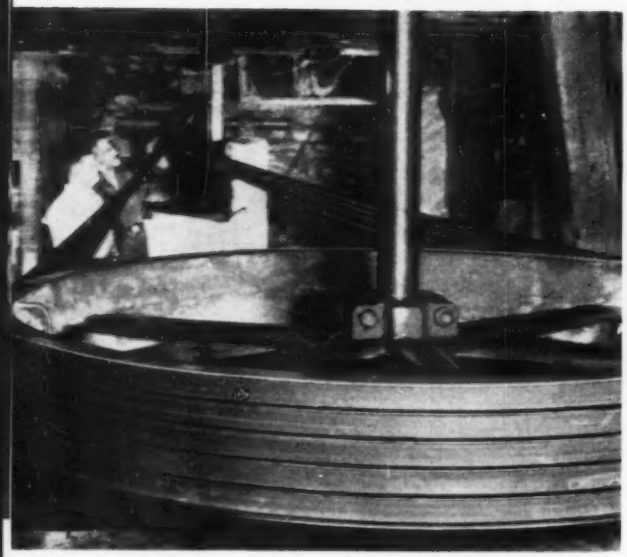
2 Horizontal cross section through the variable-displacement pump in Fig. 3 shows how the piston-assembly position is adjusted to control the output of the pump



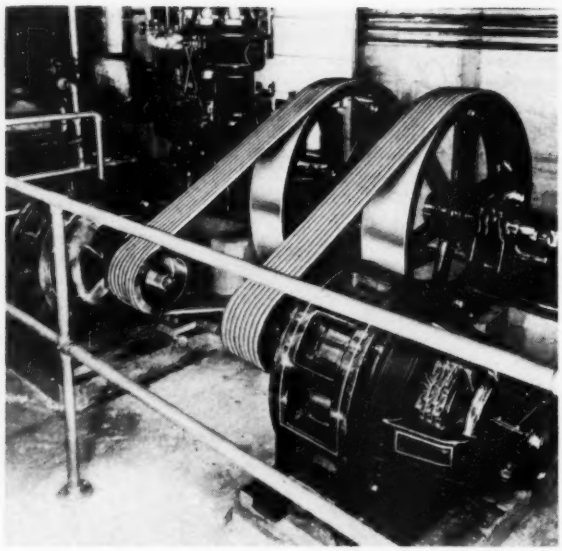
3 Radial-piston pump with pistons and floating ring R in zero-capacity position, A. At B, the pistons and floating ring are shown in the pumping position for this unit



4 Self-unloading radial-piston pump with its pistons in the pumping position, A. At B, the pistons of this pump are in the zero-capacity position for the unit



THIS DRIVE, quarter turn, takes power from horizontal shaft, transmits it to the vertical one, driving a small hammermill



V-FLAT DRIVE replaces flat-belt drive on a refrigerating-plant conversion job. Note that the small sheave is grooved for V-belts

V-Belts Do a Top Job Even on Drives

By **FRANK H RUMBLE,** *Texrope Drive Specialist, Allis-Chalmers Mfg Co*

► MOST MULTIPLE V-BELT DRIVES use standard-section belts running between grooved sheaves on parallel shafts. Speed ratios are constant. But sometimes the standard grouping will not take care of the operating conditions and you need a modified drive. Here are three of these *different* driving arrangements.

Quarter-turn drives transmit power from a horizontal to a vertical shaft, or vice versa. Applications for this kind of drive are limited, but when engineered properly this means of power transmission is satisfactory and quickly installed. Here are the essential specifications. For further details consult V-belt manufacturers' catalogs.

Always use deep-groove sheaves, and a minimum center distance of 5.5(D + W). (*D* is pitch diameter of the large sheave; *W*, the width of the band of belts.) Arc correction factor may be taken as 1.0.

Arrange the rotation so the drive's tight side is on the bottom. Axis of the vertical shaft should lie in a plane perpendicular to the horizontal shaft, intersecting it at the center of the sheave face on the horizontal shaft. Center of face of the vertical-shaft sheave should be below the axis of the horizontal shaft (photo above, left).

For speed ratios greater than 2½ to 1, shortest center distance permissible may be too long for the usual quarter-turn drive. In this case, a setup with a quarter-turn drive between the higher-speed shaft and a jackshaft, plus a standard multiple V-belt drive between the jackshaft and the slower-speed shaft, often solves the problem.

V-flat drive is a common change from the usual V-belt arrangement. Here, a large flat-faced pulley is used instead of a grooved sheave, with the bottoms of the V-belts operating on the flat-pulley surface. The companion or smaller sheave must be grooved.

This type drive is frequently used on conversion drives. Characteristics of a flat pulley or flywheel originally furnished on a driven unit may make it desirable to use the V-flat combination.

These drives will give good service when they are properly engineered.

Speed ratio should be equal to or greater than 3 to 1. Ideally, center distance should be equal to the diameter of the flat pulley, but never more than 1½ times the flat-pulley diameter.

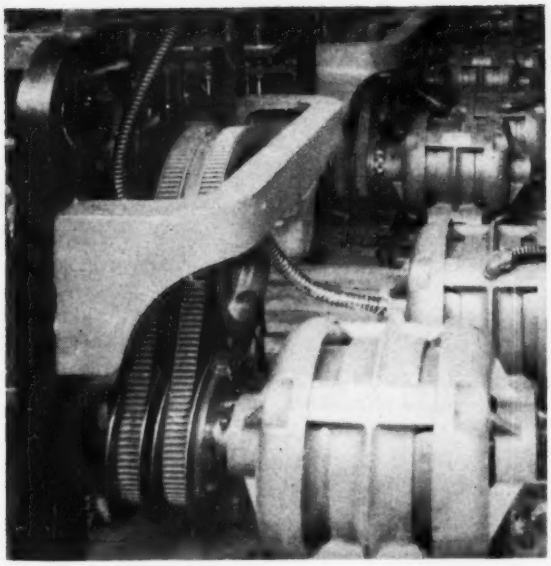
It is best to use an uncrowned pulley. But if the crown is not excessive, a drive may still operate satisfactorily. Face of the flat pulley should be about 10% wider than the face of the grooved sheave used with it.

V-flat drives are not recommended for service where shock or excessive vibration is present.

Variable-speed drives are widely used variations of the V-belt power-transmission principle. (See POWER's series, *Mechanical Variable-Speed Transmissions*, by W L Byler, May to September.) One or both sheaves are built to permit changing the groove width, thus providing a larger or smaller pitch diameter and resulting in a stepless increase or decrease in speed of the driven shaft. The variable-pitch sheave is usually made of angular-faced disks or plates that form the V-shaped groove. When disks are moved toward each other, the belt rides higher and the pitch diameter of the sheave is greater. When disks are moved farther apart, the belt rides lower, pitch diameter is less.

Center distance becomes longer or shorter as the belt rides higher or lower in the groove, and a means is always provided of compensating for this by moving the sheaves or by moving an idler.

Variable-pitch sheaves may use either one or several V-



VARIABLE-SPEED V-belt drives can be used wherever constant-speed drives can. They drive spinning frames at this mill

Off Beaten Path

belts, of either standard or special section. Some units can be adjusted while the drive is in motion, others must be adjusted when the drive is stationary.

Variable-speed V-belt drive follows somewhat the same general rules outlined for constant-speed drives. The difference depends on whether it is used for a constant-torque or constant-horsepower application. Check with manufacturers for horsepower ratings of the various types of belt used.

You can use variable-speed V-belt drives wherever a constant-speed V-belt drive is practical. Throughout industry variable-pitch sheaves transmit power from standard-speed motors and prime movers wherever there is need for low-cost mechanical variable speed.

Two variable-pitch sheaves, in combination and enclosed in a metal box or case, sometimes with a built-in gear reducer, are called a variable-speed transmission. Pitch diameters of both sheaves are changed simultaneously, and there's no change in center distance with this setup.

Moving the controlling mechanism results in infinite speed change of the driven shaft. The size, transmitting capacity and speed range of such transmissions are carefully computed; follow manufacturer's recommendations.

Special Belts. Most of the multiple-belt drives are made up from standard belts and stock or standard sheaves. Theoretically, there is no limit to the size and number of belts and grooves that can be employed.

In practice, space limitations, bearings, weight, cost and manufacturing facilities control the size and number of belts of larger-than-standard drives. Giant units have been built to transmit 3000 hp, and 6000 hp is within reason.

Such drives are made to order, using specially made "F" or "G" section belts. A "G" section belt is about 2½ in. top width. Its use, of course, is rare.

Belts for Specific Conditions

Resistant to Atmosphere

There have been many more modifications in the construction of V-belts themselves than in the grooved sheaves that they run over. This is because the sheaves are usually made of metal and are little affected by extremes of temperature, humidity and other atmospheric conditions. But belts are of vegetable or animal origin (natural or synthetic) and require special safeguards when used in certain situations.

Most V-belt manufacturers can supply some or all of these special types:

Heat resisting: Cords and rubber compounds are specially treated during manufacture to make the belt resist heat.

Oil-resisting: Neoprene cover on a standard V-belt core makes belt resistant to deteriorating effects of oil and grease.

Oilproof: Both cover and core are made of neoprene so belt is practically impervious to oil and grease.

Static conducting: Belt has static-conducting element impregnated in the cover so that it conducts static electricity to the grounded machine without probability of producing an electric spark.

Open End

A variety of open-end belts are on the market. This type must be cut to length as needed. The ends are usually joined with a metal fastener to form belts that operate in the sheave grooves.

Sponsors of open-end belting claim certain advantages. It is particularly useful in emergencies, they say, and can be installed on sheaves with through-shafting without dismantling the machine. This belting is made of (1) leather (2) rubber and fabric in continuous length (3) rubber and fabric segments that can be joined together.

Its disadvantages include the problem of belt stretch and the acute difficulty of making up a matched set of belts. Most V-belt transmission engineers advocate use of endless belts because they have no splices. Also, keep in mind that the V-belt rating tables, adopted as standard by the industry, are for endless belts.

Supercapacity

"Super," "super service" or "high capacity" V-belts have been developed in recent years. They look much the same as standard belts. But improved materials and construction let them transmit 40% more horsepower than a standard belt of the same size.

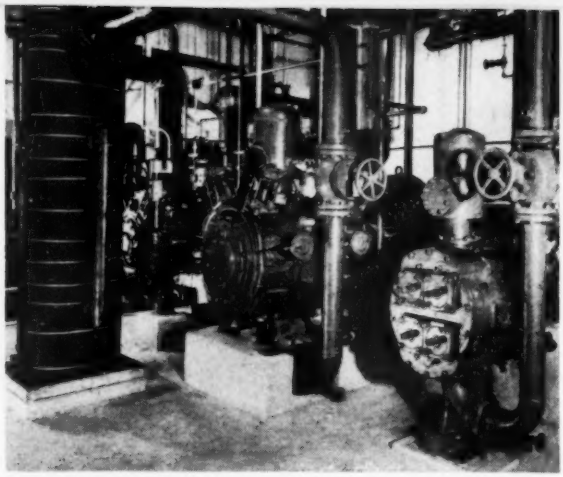
This type was originally offered for service where (1) space was limited (2) for other reasons standard belts could not be used. But this belt is now finding general use throughout industry. In a modified form, supercapacity belts may eventually supplant the present standard ones, and themselves become the standard of the future.

It is important to remember that design principles for a V-belt drive remain the same no matter what the capacity of the belt you are using.

REFRIGERATION

'Check-Out' Your Refrigerating Unit When It's New

Start-up of a new refrigeration unit or plant is a big event in any operator's life. Getting off on the right foot means you'll have fewer troubles during the coming years. Here's a quick run-down for you on the important facts



GOOD INSTALLATION does much to keep these compressors in service for many years. Check-out is always important today

SLUG OF LIQUID caused this damage to a refrigerating compressor. Rigid check of new systems can prevent troubles.

► AIRLINE AND SERVICE PILOTS must follow certain "operating" rules that power-plant operators might well imitate. Among the rules we know of, one of the best is what pilots call a check-out. The check-out is made before take-off, and on some planes may require more than an hour. But the pilot knows that all is well before he gives his plane the gun for a trip.

Refrigeration Units. You should feel as safe before starting a new refrigeration machine as the pilot does when he opens his throttles. The only way of getting this peace of mind is through a careful check-out before starting a new plant or equipment that has just been overhauled.

Jobs installed by a contractor or consulting engineer will be tested before the equipment is turned over to plant personnel. This is one of your best chances to get acquainted with your units. If you can keep them running at guaranteed efficiency at all times, you'll really be a dollar-maker. So work closely with the contractor or engineer—you'll learn plenty that will help you in later years. Of course, if you're starting a new plant yourself, or starting equipment after overhaul, you'll have to perform many jobs the contractor does.

Check-Out. Best place to start is at the controls, going from there to the interlocks, thermostats (if used), regulating valves, lube-oil system, piping, pressure units, cooling and air-distribution systems. Exact order isn't too important if you're positive that no part of the system is overlooked and that each check is thorough.

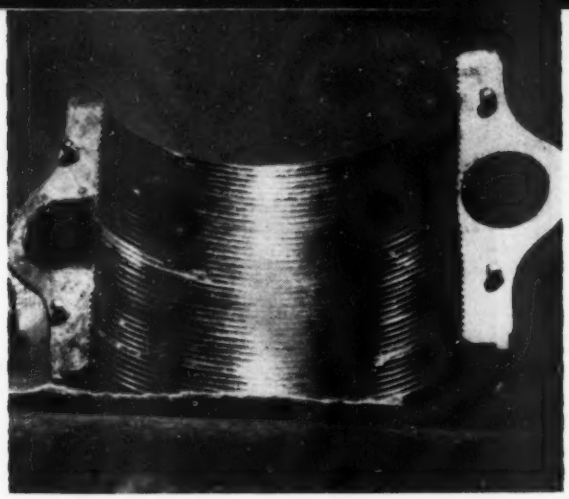
Controls vary with job type, but most air-conditioning and similar systems using reciprocating compressors have high- and low-pressure cutouts. This is called dual-pressure control.

Set low-pressure cutout so it starts compressor when suction pressure reaches the value corresponding to suction temperature desired. Set high-pressure cutout, too. Don't touch pressure controls unless you have the manufacturer's instructions for them. Follow the instructions exactly—otherwise, you may run into trouble when you start the compressor.

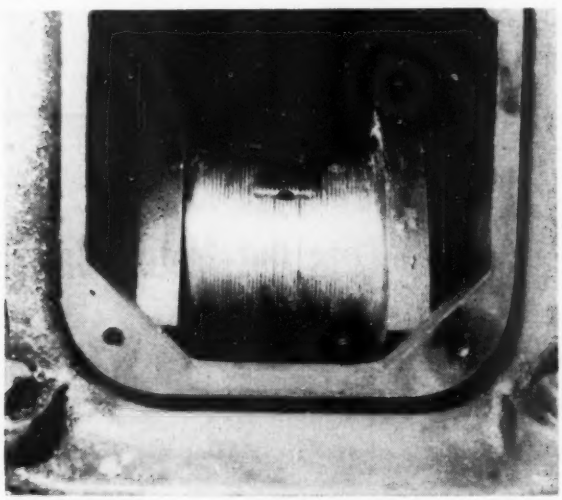
Be sure to adjust differential points as low as you can without causing compressor to start and stop too frequently (short cycling).

Interlocked systems are popular for air conditioning and jobs where it is necessary to prevent units from running in the wrong sequence. So check your interlocks to see that they function right.

Interlocks are used to prevent compressor operation when (1) condenser is out of service (2) air-conditioning fans are not running (3) a liquid solenoid valve is closed, etc. To see that each interlock functions right you must set up conditions that would cause it to stop the compressor or prevent it from starting, depending on how the unit is to be locked out.



POOR LUBRICATION, one of the worst enemies of good operation, is the culprit. Never overlook importance of oil feed



CRANK JOURNAL severely damaged by bearing, *above*. Not only do you lose service of the machine, you must also repair it

Regulating Valves. Apply head pressure to the condenser and check flow through cooling-water regulating valve. Adjust valve to give right flow. If you cannot adjust it to give desired flow, check the inlet pressure. Most water-regulating valves have an upper limit for inlet pressure, and if city-water pressure is greater, a pressure-reducing valve must be used in the line.

Expansion Valve. If this has been preset at the factory it is best to operate the system to check refrigerant feed to evaporator. Factory-set valves don't need adjustment often.

If valve isn't preset, check superheat adjustment by reading refrigerant temperature in the suction line at the thermal bulb. Best way to measure gas temperature is by installing a thermometer well in suction line close to thermal bulb. If suction tubing is too small for a well, clamp thermometer to outside of tube. To insure an accurate temperature reading, get as good a bond as possible between thermometer bulb and tube. Make final adjustment of expansion valve when evaporator is running at or near needed temperature.

Thermostat is set to keep room at the desired temperature. If unwarranted resetting is to be prevented, protect thermostat with a suitable guard.

Lube Oil. Small compressors that are charged with refrigerant at the factory are also filled with the correct amount of oil. But before starting the unit, check oil level to see it is correct.

Large compressors that must be charged with refrigerant in the field must also be filled with oil before unit is started. Use only the grade recommended by the manufacturer, keeping it clean and moisture-free by storing in closed containers.

Add oil either by pouring into crankcase or drawing in by the vacuum created by the compressor. See manufacturer's instructions for best procedure.

Piping. Don't make the easy mistake of leaving rags, tools or anything else in the piping. Check all lines and valves before charging the system.

See that gages are connected to the suction and discharge lines, and to lube-oil piping. Open gage cocks—a closed cock can lead you astray during start-up, with resulting damage to the system. Connect all thermometers.

Start-Up. Open condensing-water control valve and check discharge of water from condenser. Inspect compressor to see it is free to turn over and that no tools or other equipment are near the flywheel and drive. Check oil level. Open suction and discharge valves in the refrigerant lines.

Bar compressor through several revolutions by hand so you're sure there are no obstructions to its free movement. If bypass valves must be open for correct starting, open according to manufacturer's instructions.

Start and stop compressor several times, allowing unit to run for about ten seconds each time. Check system pressure gages.

Running Check. Operate the system for 72 hours, keeping a service man on the job at least 48 hours. Watch compressor oil level closely at all times while system is running. Take voltage and amperage readings on all motors at the start of the running check. This prevents damage from overheating. See that these readings agree with nameplate values.

Once system carries load, examine all controls, resetting if conditions are not right. Inspect piping for leaks, using a gas detector. Read and record operating temperatures and pressures. See that suction superheat is right.

Final Check. After system has run 72 hours it should be shut down and carefully inspected. A run of this duration gives the system's units time to run in, and any major faults should show up.

Check oil level, refrigerant flow, expansion-valve superheat setting, evaporator pressure regulator, head and suction pressure, shaft seal, alignment, pipeline strainers, air-handling units.

Once these items have been checked and found OK, you are ready to run the system for a full week. Most compressor manufacturers recommend an additional inspection at the end of this period. See their instructions for the best procedure.

Remember, hints given here are only general. Each make of compressor is a little different from others and you must follow slightly different procedures. This article will show you a good start-up schedule that will serve for both new and older units.

Photos from The Hartford Steam Boiler Inspection & Insurance Co.

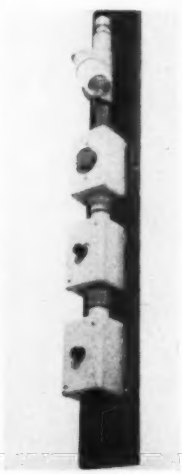
Simple Devices For Plant Safety

These five shop-designed and shop-made safety gadgets are simple, effective, easily duplicated. Photos on these pages show how they're made, what they can do in your plant

'No Smoking' Blinker

Easily portable "no smoking" sign immediately commands attention by blinking a warning wherever it is placed. This unit has a base that is 6¾ in. in diameter, 6 in. high. Plant personnel can read the words on the 24-in.-high triangular wooden sign from any direction. Black letters on yellow background convey the message.

Red blinker light mounted on top of the wooden sign is a 1000-v helicoil bulb covered with a red glass globe. It blinks on and off approximately 60 times a minute, runs on a "B" battery and a 1000-v stepup transformer contained in the base. Entire unit weighs about 12 lb, is 35 in. high.

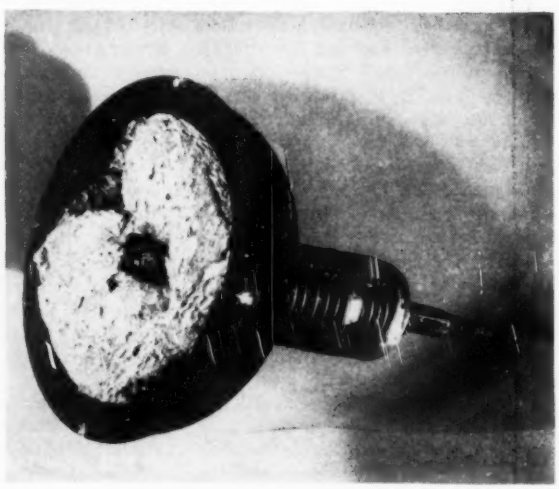


Cuts Out Match Carrying

If smoking is permissible in specified areas of the plant, but matches should not be carried in others, these simple lighters cut down on safety infractions. One type is patterned after the automobile dashboard lighter. The other uses standard electrical fittings and easily removable heating elements. Maintenance costs are low for both models.

Eliminates Flying Chips

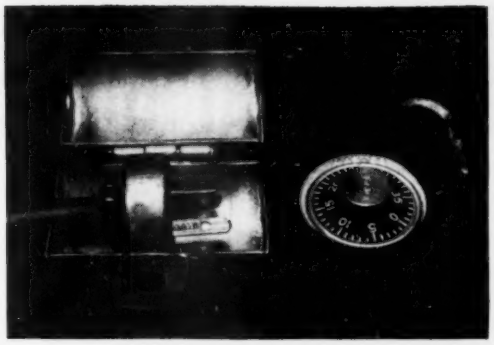
This guard for a star drill consists of a suction cup from a "plumber's helper" and two cellulose sponges, fastened to the bit with a spring collar and setscrew. The springs are in sections and are adjusted to fit any length bit. Sponges can be dampened with water to help prevent fires and keep down dust, without using wet rag or hose.

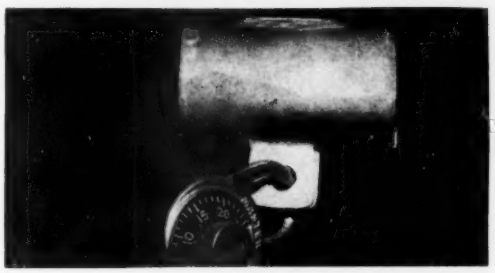


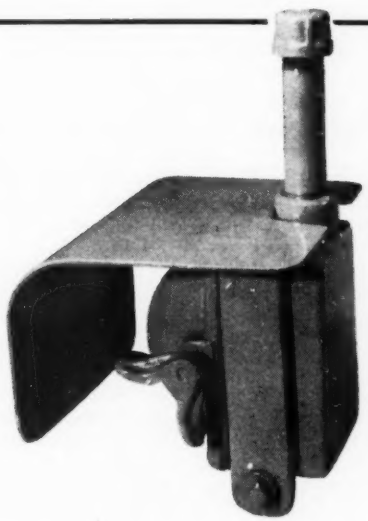
Power's thanks to E I du Pont de Nemours & Co, Inc, Petroleum Chemicals Division for the material for this article.

Keeps Plug Out of Socket

This lockout device prevents putting extension-cord plug into an electrical receptacle while maintenance man is working on the equipment. Device is both easy to make and easy to use. It is particularly useful on electrical office equipment, power tools and laboratory apparatus where locking switches are not provided.







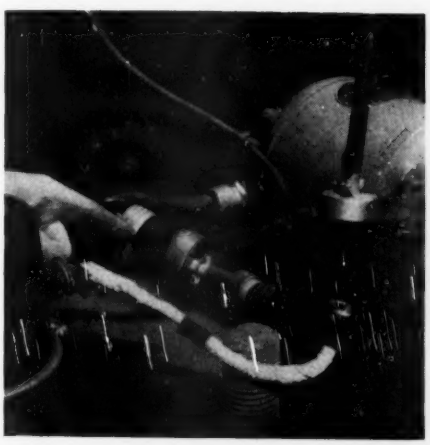
Guards Butterfly Switches

Metal guard gives double protection to the butterfly type of electrical switch. It protects against overhead leaks or falling objects. It also prevents anyone from starting the equipment accidentally by leaning on the switch or inadvertently coming in contact with the lever.

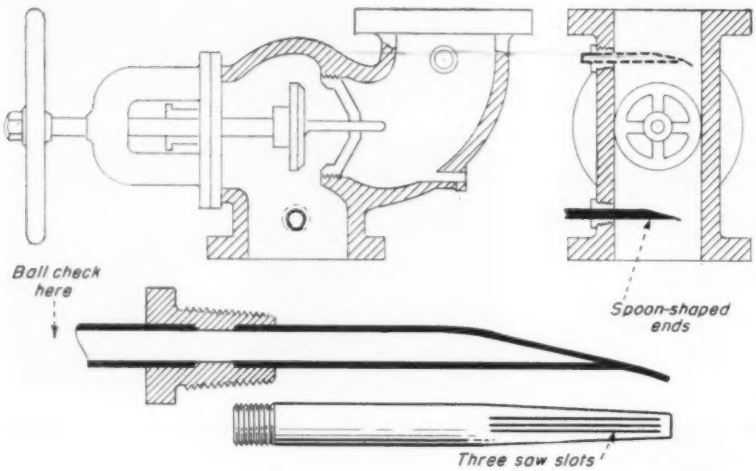
More Disconnects—Less Down Time

Today's electrical designers are getting good results with quick-disconnecting designs in switchgear, motor-control centers, etc. Users appreciate being able to quickly pull an electrical component out of place for maintenance, trouble shooting or simply disconnection. This is a big safety feature, and it promotes better maintenance.

Operating men can adopt the same idea for small motors, solenoid valves, etc. Use twist-type disconnects that can be easily inserted by cutting into the feed. When trouble shows up, disconnect the balky unit, slip a new or repaired one into position, and resume production. The faulty device can be repaired back in the maintenance shop. This generally adds up to a better repair job than if all the work were done hurriedly in the field.



PRACTICAL IDEAS...here's the trading post for your



Prevent Failure by Oiling Newly Bored Cylinder

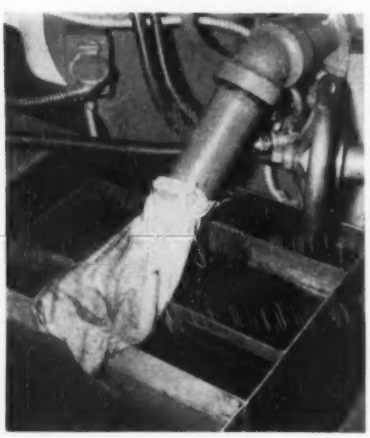
PROBLEM OF INTRODUCING OIL to an engine's cylinder wall after a reboring job causes an anxious moment. You worry about: (1) new piston being right size for rebored cylinder (2) preheating the cylinder casting to prevent steam condensing as it enters cylinder and thus washing off all the cylinder oil (3) steam quality entering cylinder and length of line to engine (4) initial speed of engine and length of run before throttle is opened wide.

During this first run, cylinder oil must be forced into the steam line so it atomizes and lubricates every part of the newly bored cylinder walls. That brings up this question: "How should cylinder oil be introduced and at what point in the system?"

I prefer using a "spoon," made by filing down a piece of ¼-in. pipe as shown. Best location is under the throttle valve, shown black in sketch. At this point atomized oil is not carried through the various steam-valve passages, but is sprayed directly into the cylinder ports, where it's needed most.

J POVALSKI *Brooklyn, N. Y.*

EDITOR'S NOTE: *Reader Povalski is foreman for Edward Purvis & Sons, a steam-engine repair shop. He has been rebuilding engines for years and is an authority in his field.*



Collects Diamond Sludge

THIS CLOTH SACK is tied around pipe that bleeds off both coolant and sludge from a grinder at Edmore, Mich. plant of Carboloy Department of General Electric Co.

Cloth bag is used only when diamond wheels are in operation. This method saves thousands of dollars by collecting diamond sludge and making reclaiming process economical.

EDITOR'S NOTE: *Sack idea should be valuable for keeping grinding sludge out of cutting oil and for a lot of other uses. Then sludge won't wear out mechanical seals on cutting-oil pump.*

Unplugging Plugged Blowoff Lines

A PLUGGED BLOWOFF LINE is serious. If in doubt, test when taking over a watch. Blowoff lines get plugged from loose scale or things left inside. Boiler makers often stop opening with a rag, when working in boiler, to keep scale, etc, from falling into the opening.

Boilers with blowoff line in furnace, like hrt boilers, often give trouble. Protect such lines with V-shaped brick pier in furnace. Or enclose blowoff piping completely. But it's best to construct so you can see pipe while boiler is in service. Have peek hole in back wall, or remove a few loose bricks protecting rear clean-out door.

Blowoff line usually gets plugged when boiler is taken off line for cleaning or inspection. Loose scale left inside falls off when boiler is fired. Then scale finds its way into blowoff line.

When scale falls from internal surfaces because of feedwater treatment, open blowoff valves often to blow them out. If valves are not opened often scale packs in line and plugs it. Clicking sound in lines when blowing down is warning of scale.

Plugged blowoff lines can often be freed by blowing back if you have two or more boilers, connected in battery. Take boiler, with plugged blowoff, off the line, and allow pressure to drop about 50 psi. Raise water level in boiler next to it. Then, if possible, place a stop valve on end of main blowoff line and close it. Then open blowoff valves on boiler with plugged line. Station a man in front of boiler to watch water level. Another man can open blowoff valves on boiler and blow back into plugged line. After it's free, remove stop valve from main blowoff line. If possible, open and inspect boiler with plugged blowoff line internally.

If plugged line cannot be blown free by this method, then you may have to pump water out or remove blowoff valves and try to free line with a stiff wire. Another way is to split blowoff pipe and let water run out.

A CARTMAN *Albuquerque, N. M.*

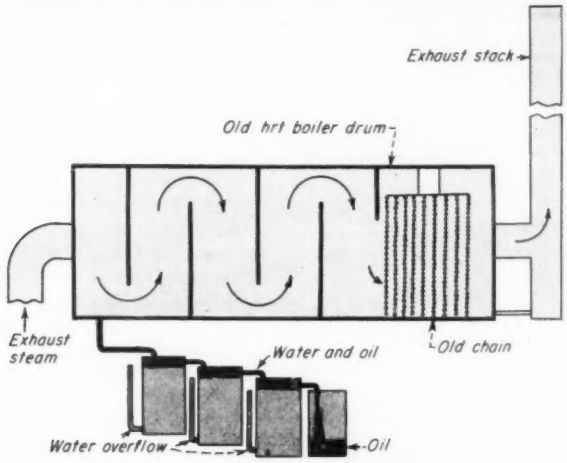
Cut Packing Right

MITER BOX with low sides helps make each cut of rope packing same angle. Attach a wooden foot rule on side to make measurement easy.

H HOLCOMBE *Los Alamos, N. M.*

operating and maintenance short cuts

STEVE ELONKA, *Associate Editor*



This Oil Separator Stops Oil

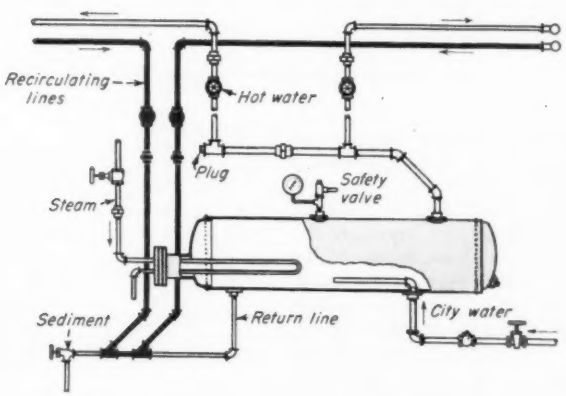
EXHAUST-STEAM ENGINES in a sawmill exhausted direct into 16-in.-dia stack, 80 ft high. Mill is near a parking lot and a bridge with curved approach.

Mill roof had a thick coating of oil and sawdust from cylinder oil in exhaust steam. Walls and windows couldn't be kept clean, either. Even parked cars had an oil deposit, which was hard to remove when windshield wipers were turned on. Also, it was hard to see through the windshield. When rain came after a dry spell, cars approaching bridge often skidded dangerously. One bus skidded into the guard rail.

We solved problem by removing oil, as in sketch. Oil nuisance is almost stopped. Besides, one 45-gallon barrel of cylinder oil is salvaged each month.

Decreased velocity of steam past baffles, and scrubbing action through chains deposits oil and water in receiver. From there it flows through a series of barrels, where oil is separated.

H H WRIGHT
New Westminister, B. C.

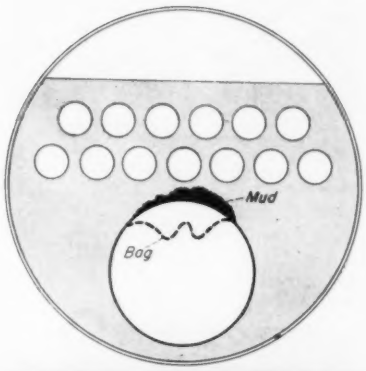


Return Line Gives Up Plenty of Hot Water

WE HAVE more than enough exhaust steam for heating hot water, but it is used so far from its storage tanks in some places about the plant that we used to waste too much. Besides, water is metered and costs money. Obvious answer was to recirculate the hot water.

Sketch shows hookup of hot-water system, with ½-in. recirculating lines. System works so well, gives so little trouble, I show all piping connections.

A BELTON *Montreal, Quebec*



Smart Engineer Prevents Explosion

WHAT GOES ON just before a boiler explodes—when it stops short of catastrophe? A Scotch marine boiler in a milk plant came within inches of a blow when the attending engineer looked in the firebox. He saw the top sheet of the corrugated furnace bulging down into the flames of the stoker-fired furnace.

Before you could say "Skat," he cut the fire and released the safety valve. Pressure and temperature dropped fast enough to avert an explosion.

When the boiler had cooled and all danger was past, the firebox walls had poked about a foot into the firebox.

Insurance inspector later found that a thick layer of mud had deposited on the plates, making an excellent insulation between boiler plate and water. That softened the steel as temperature rose. Then pressure within boiler rapidly stretched the sheets to breaking point, just as alert operator discovered the danger.

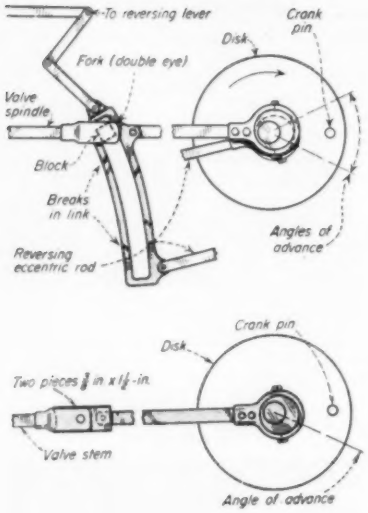
Like every process where metal is stretched, resulting section becomes thinner. In a boiler, thinner section became progressively weakened under the tons of pressure built up over its surface by the steam.

E G GREGORY *Reedsburg, Wis.*

(*Continued on page* 126)

More PRACTICAL IDEAS

Begins on page 124

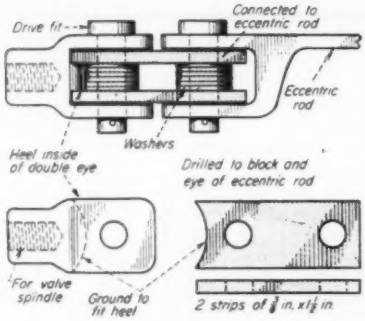


Fast Repair Saves Shutdown

I WAS CALLED out one early morning to repair the 14x16 hoisting engine. It hoists coal from lower section to a distribution center. Major output of mine depended on this engine.

Valve-gear link was broken on one side, top sketch. It was cast-iron, and we couldn't weld or braze it. Assembling all pieces with block in place, we measured centers of holes in block and lug link, which connects to fork (double eye) of eccentric rod.

I cut two pieces of ⅜x1½-in. steel, ground ends to fit heel inside of valve-spindle fork. I drilled two ¾-in. holes in each piece to centers of block and to link's lug, top right sketch.


Drive fit
Connected to eccentric rod
Eccentric rod
Washers
Heel inside of double eye
Drilled to block and eye of eccentric rod
For valve spindle
Ground to fit heel
2 strips of ⅜ in. x 1½ in.

While this was going on one man took off the eccentric strap and the rod on reversing the eccentric to prevent it from flopping about as it was disconnected from valve spindle. After drilling correct centers in ⅜ in. x 1½ in. pieces, it was quick work to connect eccentric rod to fork (double eye) of valve spindle.

A quick check of valve setting proved no further adjustment was needed so we started engine. We could still reverse engine on other undamaged side, providing crank was off center. But this wasn't important because weight of coal provided momentum down grade.

About 350 men were going to return home because of broken engine. But this repair prevented a shut down.

Engine continued to operate on this makeshift valve connection until a new brass link was delivered. We installed it at leisure on a weekend.

V STRAJIC *Glace Bay, Canada*

Why Wouldn't Engine-Driven Pump Start?

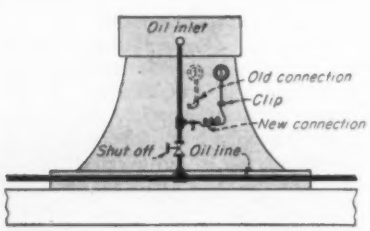
OUR PUMP HOUSE has a little standby emergency pump driven by a 6-cylinder gasoline engine. We start this engine once a week to be sure it'll run if needed.

Pump gave trouble one week, then finally started. I stopped and started it several times, but there was no sign of trouble. It didn't start first time next week. Engine has conventional cranking motor and Bendix assembly; motor is energized by a relay operated by start button on control panel.

When I pressed start button, there was a POK-like noise, and that was all. Contacts on starting motor relay were OK. I had visions of pulling down motor and Bendix assembly till I tried it again, watching closely this time. POK again. I noticed the cranking motor worked all right, but something seemed to be holding engine from turning. I asked mechanic if he had noticed anything unusual in its operation during past few weeks.

"No, except I have to add a little water to the radiator each week," he replied. That was enough for me. I started pulling plugs. Sure enough, one cylinder had water in it. We found later that a slight flaw in block (probably a sand hole in casting) allowed cooling water to leak into cylinder. Not enough water leaked to cause noticeable change in operation. But with engine shut down for a week, enough water leaked in to keep her from turning over until it worked out.

ED ECKERT *New York, N. Y.*



Coils Snub Pulsating Gage

BEARING OIL, registered on pressure gage on our big turbine-generator, pulsated. Cause was gear-type main oil-pump, driven from turbine shaft. Pulsations were of about three pounds' magnitude, not enough to prevent an average reading, but frequency would cause rapid wear on gage mechanism.

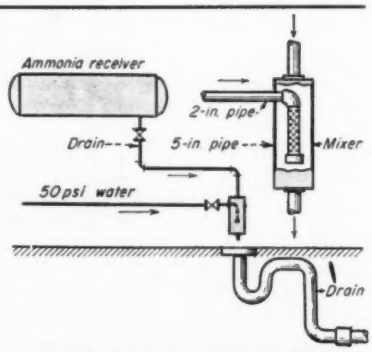
Throttling or snubbing with petcock was not possible because when it was snubbed enough to stop pulsations, it would shut off entirely.

Gage was connected to oil line by a straight run of 1/16-in. copper tubing as shown by dotted lines, in sketch. We replaced this with a longer piece having a coil of five turns. Winding, on a 2-in. mandrel, was supported to give the coil free play. Coil absorbed pulsations and gave a steady gage with a cock wide open. We were afraid to use a small orifice that might clog with dirt.

We had no exact rule for the number of turns and used the cut-and-try process. If turns in coil are too many or too few, pulsations will continue.

Best way is to test coils for pulsations after adding each turn. Then stop coiling when pulsation stops.

A H MOULTON *Pittsfield, Mass.*



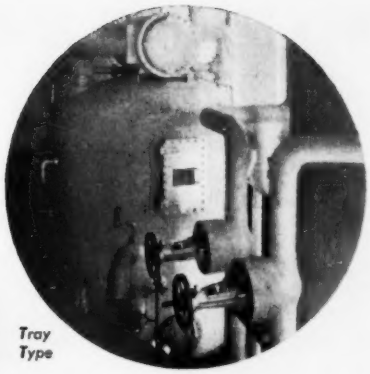
Dumping Ammonia Safely

SKETCH SHOWS a successful method of dumping liquid ammonia directly into the sewer. To make a harmless solution, 2000 lb of ammonia would require about 40,000 lb of water.

M E EVANS *Chicago, Ill.*

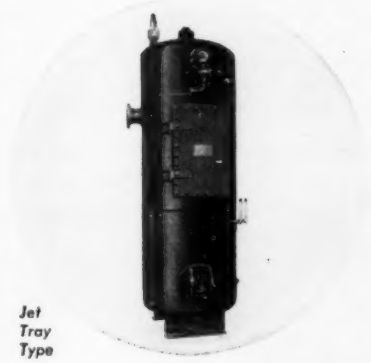
(*Continued on page* 128)

DEAERATOR TYPES FOR ALL SERVICE REQUIREMENTS

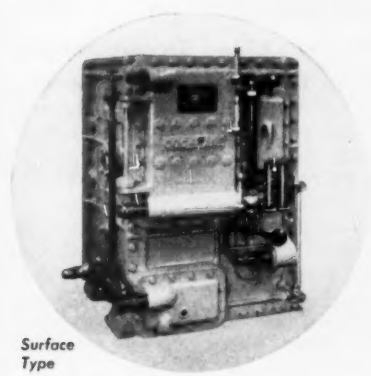


Tray Type

Atomizer or Spray Type



Jet Tray Type



Surface Type

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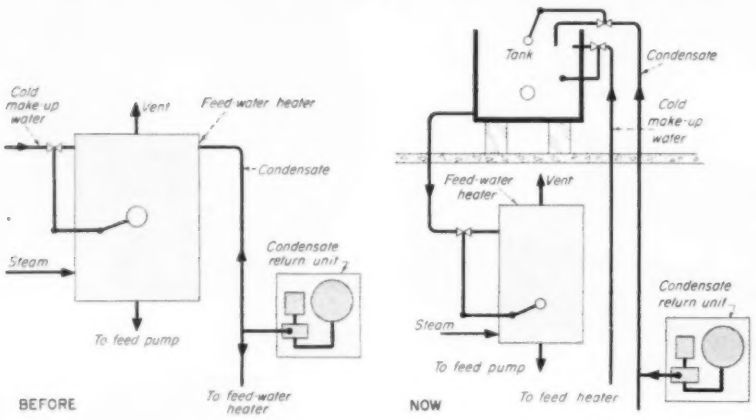
More PRACTICAL IDEAS

Begins on page 124



Feedwater Heater Hook-Up

As installed, a condensate line was piped direct to feed-water heater of a waste heat boiler. Cold make-up water was also piped to this heater and controlled by a float located inside the heater, sketch, *Before*. Condensate was being pumped to heater from a process plant by a motor-driven pump controlled by an on-and-off float switch. Owing to pump's intermittent operation, heater got more condensate than it needed whenever pump was running. But only cold water came through at other times. This caused unsteady feed water temperature and an excess condensate overflow.

To ensure minimum make-up water to this heater and to avoid condensate waste, we modified as in the sketch, *Now*. Both condensate and cold makeup now feed an overhead tank (well lagged and roofed) and both lines have float-controlled valves. Condensate valve closes only when tank is full. Make-up water valve opens only when level in tank drops to less than one-third of full tank level.

Float inside heater now regulates flow from overhead tank to heater. When overhead tank is full, condensate valve is closed by float and surplus condensate flows to another heater at a higher elevation in main boiler plant. This system has been operating very satisfactorily for the past two years.

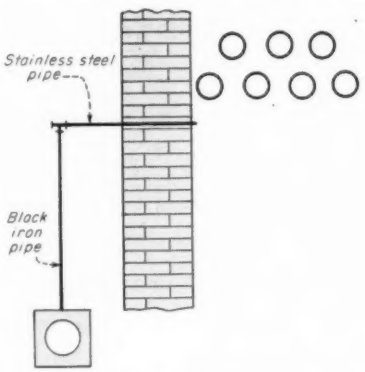
A Ranganathan *Alwaye, S. India*

Draft Stops Slagging

We had a serious slagging condition on outside of bottom-row tubes in 120,000 lb per hr cross-drum watertube boiler. Boiler came off the line about every two months for deslagging. Fuel burned was anthracite No. 3 buckwheat size, commonly known as barley.

Fine sizes of anthracite coal produced a lot of flyash, mostly small flakes of unburned coal during combustion period. Some of this flyash burns in suspension while passing upward through the furnace. It produced a slag formation on bottom row of our tubes. Condition kept getting worse as slag accumulated. If let go too long, it would bridge over openings between tube spacing and eventually block off the draft.

We burn this fine-size anthracite coal

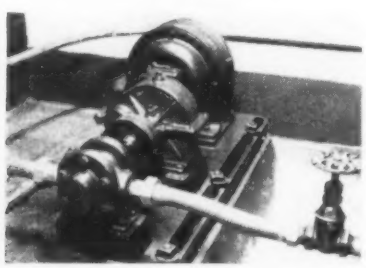


on chain-grate and traveling-grate stokers, usually maintaining a slight pressure or balanced draft over the fire.

While trying to remedy this slagging condition, we checked the draft conditions slightly below bottom-row tubes. There was a pressure. We, therefore, changed our forced- and induced-draft conditions to produce a draft of not less than 0.05 in. of water, at a point about eight inches below the bottom-row tubes. With draft at this point, flyash is carried up between tubes and passes before it has a chance to stick to tubes and form slag. We now operate boiler much longer periods without deslagging.

A 24-hr recording draft gage, sketch, helps operator maintain a constant minus draft below these tubes.

E E Smith *Clark's Summit, Pa.*



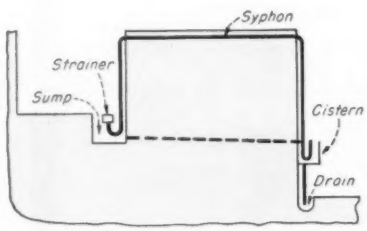
Flexible Lines Save Packing

Fuel-oil pumps in our plant had to be packed twice a year when suction and discharge lines to pump were standard pipe. Difference in oil temperatures evidently caused pump to be moved slightly out of alignment.

I replaced lines with short sections of flexible metal hose, photo. That was five years ago. Pumps have not been repacked in that time.

Now we solve similar problems around our plant by installing flexible lines.

W J Heim *Rahway, N. J.*



Self-Priming Siphon

An underground pipeline (dotted line in sketch) carried away acidic wastewater from an underground sump to drain at lower level. Line had to be replaced after some years of service. Replacement would involve an immense amount of excavation as pipeline was about 30 ft long and 10 ft below ground.

We installed siphon setup (solid line) to replace old pipeline. U-loop on each end saves priming siphon as action is automatic when pump fills.

A Ranganathan *Alwaye, S. India*

Broom Handle and Cork

Ed Eckert (July Power) will find that broom handle works a lot better for removing light bulb bases (that bulbs have broken in) if he secures a cork to end of handle.

H Holcombe *Los Alamos, N. M.*

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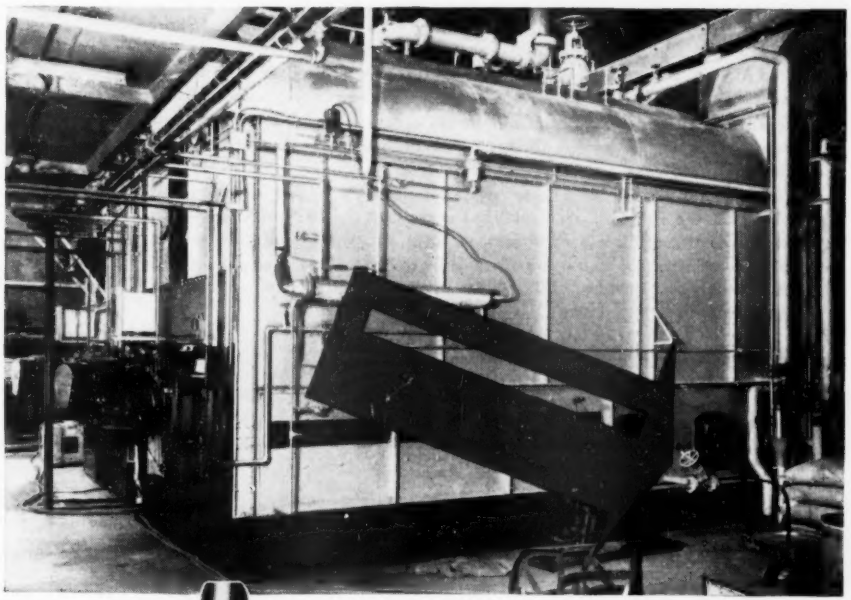

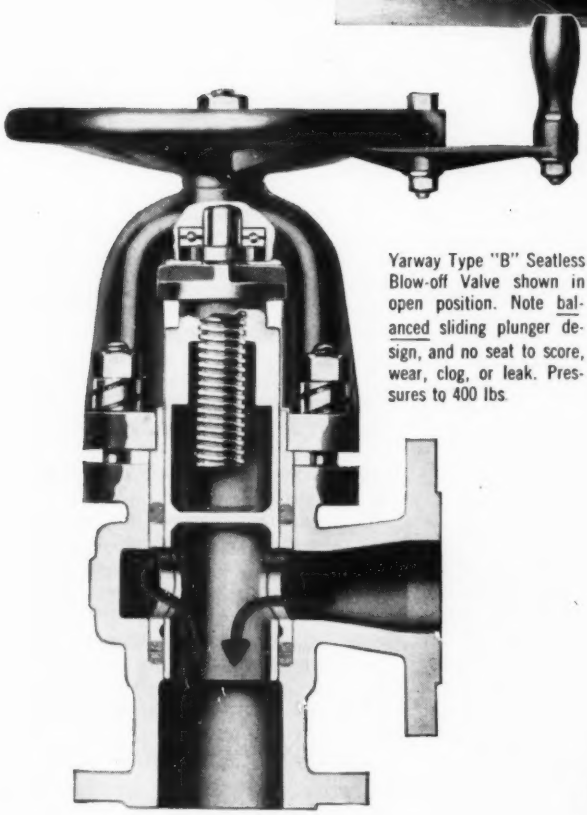

Yarway Type "B" Seatless Blow-off Valve shown in open position. Note balanced sliding plunger design, and no seat to score, wear, clog, or leak. Pressures to 400 lbs.

■ The above installation of two 300 hp. Erie City VL type boilers at a Detroit automotive plant shows Yarway Seatless Blow-off Valves as part of the "package" picture.

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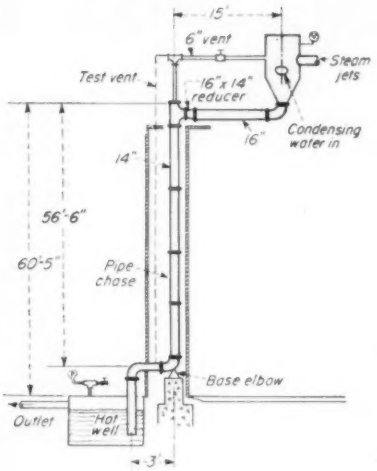
What Causes Tail-Pipe Water Hammer?



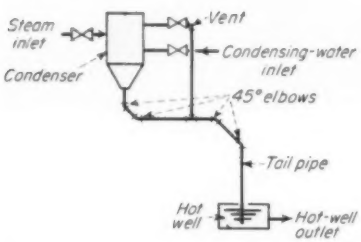
HERE ARE THE FACTS: We installed a steam-jet refrigeration system with barometric condenser, fitted with secondary ejector and inter-condenser, and a third-stage dry ejector.

After start-up, there was a distinct, loud water hammer in tail pipe near 90-deg base ell. It wasn't heard when condenser vacuum was less than 27.8 in. Hg, nor when steam ejectors were turned off and condensing water flowed through tail pipe alone. Except for this water hammer, system operation was fine.

We need 29.75 in. Hg to get chilled-water outlet temperature of 40 F. We couldn't get it without accepting the hammer, changing steam jet to get higher compression ratio, moving installation so tail pipe is vertical, or changing the 90-deg ells to form a slight angled flow at hotwell bottom. All solutions seem too expensive except the water-hammer acceptance.

Test vent, to draw air out of tail pipe, didn't work. Increasing tail-pipe vent from 2 to 6 in. did no good.—*EM, Aug Power*

Here Are the Answers



LIMIT velocity of hot water in the tail pipe to 5-8 ft per sec. This reduces the possibility of water hammer. Facts *EM* gives indicate that high fluid velocity causes the hammering because condensing-water flow increases as condenser vacuum does.

Use the well-known impulse-momentum theory to analyze conditions in the tail pipe. Most books on mechanics outline the procedure to be used when solving problems of this general type.

If computed velocity when vacuum is 29.75 in. Hg exceeds 10 ft per sec, increase pipe and fitting size to reduce velocity to a range of 5-8 ft per sec. Use gradual pipe-size reductions and avoid sudden changes in the direction of fluid flow. Sketch shows how 45-deg elbows can be substituted for 90-deg.

H B WAYNE *Brooklyn, N. Y.*

HOT WATER contacting cold metal, steam mixing with cold water or contacting cold metal cause *EM*'s trouble. If water slugs from the inter-condenser or the condenser alternately floods and runs dry, water hammer will be set up.

Try drilling a hole in the elbow into which a plug baffle can be screwed. Hole should be ½ or ⅝ in. diameter with provision for adjusting baffle setting. Set baffle at different angles and listen for water hammer. If hammer stops, fasten baffle permanently in the condenser tail pipe.

C G HOWARTER *E. Peoria, Ill.*

TWO CAUSES of hammer that *EM* should investigate are (1) air leaks in the leg or tail pipe (2) tail pipe too short for the vacuum in the system.

Carefully check tail pipe for leaks at fittings, joints, and in the pipe itself. Small leaks are difficult to track down but can cause severe water hammer. Pin holes in the pipe may be especially troublesome on jobs of this type.

Check the distance from the bottom of the barometric condenser to the lowest level of water in hotwell. In my opinion, at least six to eight feet of additional piping should be attached to the minimum length required for the vacuum to be carried.

FRED A DOERRIL *Fort Worth, Texas*

IN OUR PLANT we had a similar installation, as sketch shows. Our first step to cure water hammer was to replace the two lower 90-deg elbows with two 22½-deg elbows. When condensing-water temperature was 70 F or less, no water hammer occurred after this change.

During the summer, however, condensing-water inlet temperature rose to the 72-75 F range. To maintain our desired vacuum in the condenser, 28.4 in. Hg, condensing-water flow had to be increased. Once again we were plagued with water hammer.

Our theory on the cause of the hammer is based on many observations of this unit in operation. We believe that vapor entrained with the cooling water causes bubbles in the tail pipe. When these bubbles collapse, water hammer occurs.

Now we intend to extend the 6-in. vent line down about 30 feet into the tail pipe. We will cut slots in the vent line so any vapor mixed with the condensing water in the tail pipe will be drawn into the condenser.

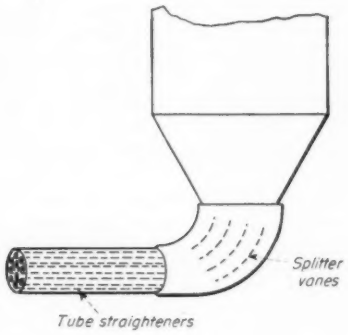
If this does not cure our hammer, we will raise the water level until it is the same height as the horizontal line leaving the bottom of the condenser. With this hookup there will be no vapor space in the tail pipe. This will prevent water hammer no matter how much condensing water is pumped through the unit. We'll keep POWER readers informed on the outcome of our tests.

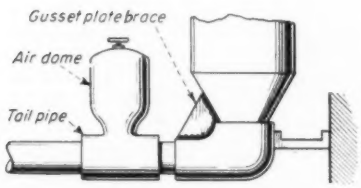
E E MOSS *New York, N. Y.*

For this month's two new questions from Power readers, turn to page 134

help the other guy cure his headaches

TYLER HICKS, *Associate Editor*





IF FLOW in a pipe is shut off by a valve, the kinetic energy of the moving fluid is converted to pressure energy, the amount of conversion depending on rate of valve closure. If valve closes quickly, shock waves that cause water hammer may be set up. These waves reverse flow several times before dying out.

EM's pipe has no valve, and flow through it is continuous. Shock waves here are caused by the increase in pressure resulting from an abrupt change in the fluid's velocity. Since kinetic energy varies as the square of the velocity, a small change in velocity can cause a considerable change in kinetic energy.

In flow through a bent pipe the velocity at the inside radius is about one third that at the outside radius. Normal velocity in the line approaching the elbow decreases much more rapidly at the inner radius than at the outer. This effect is greater in a 90-deg elbow than in one of 45 deg.

I think the velocity reduction at the inner radius tends to cause a sizable pressure increase that is not quite sufficient at 27.8-in.-Hg vacuum to cause water hammer. But as vacuum is increased, water velocity in pipe rises, energy conversion increasing as the square of the velocity change. Water hammer occurs. If my assumption is correct, the hammering increases as vacuum does.

If this reasoning has some merit, then two solutions appear possible (1) lessening the conversion effect (2) damping the hammer after it occurs.

Reducing the pressure increase means the flow pattern through the elbow must be changed. Steel-tube straighteners, top sketch, might alter flow pattern to some extent. Splitter vanes in elbow would probably alter pattern more than tube at elbow entrance. Perhaps a combination of both tubes and vanes would be best. Splitter vanes might also act as baffles to dampen shock waves producing water hammer.

Lower sketch shows how an air dome might be used to dampen shock waves. It might be advisable to stiffen the elbow, as shown.

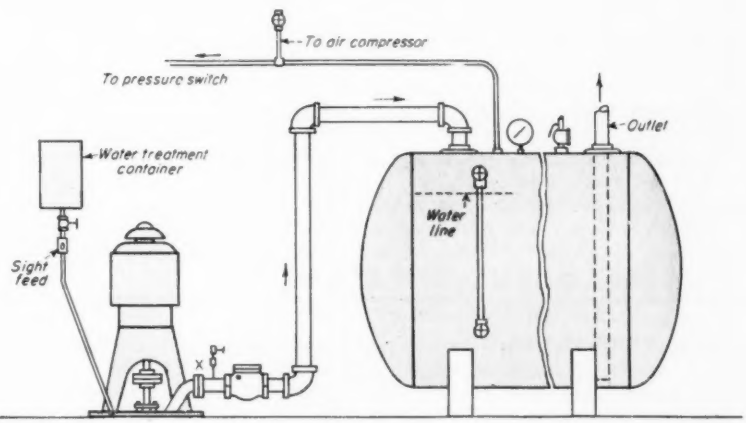
H J WYMAN *Boston, Mass.*

How Can We Stop Corrosion in Well?

HERE ARE THE FACTS: Our cooling systems are served by several deepwells. Each well has a 4-in. pipe that discharges water to our heat exchangers and condensers. Well pressure is 90 psig with fairly steady flow rate. Water temperature is 58 F.

What hookup will control corrosion in both lines from wells, in heat exchangers and condensers? Is periodic acid cleaning of heat-exchange units better than continuous chemical treatment? Which is best for a moderate-size industrial plant?—*ST, Aug Power*

Here Are the Answers



MOUNT A TANK, as in sketch, and feed treatment chemicals directly into the well. Have a complete analysis made of the water before choosing treatment chemicals. If pump setup is different from that in sketch, chemicals can be injected at point *X*.

GEORGE GRIFFEL *Bronx, N. Y.*

CONTINUOUS chemical treatment is best solution for *ST*'s problem. Use a good proportioning pump to feed chemicals to system.

HENRY RASMUSSEN *Crystal Lake, Ill.*

WELL SPECIALIST will save *ST* plenty of headaches and money. See POWER, August 1951, for two excellent articles on wells and their care.

D L COCHRANE *Milica, Minn.*

(*Continued on page* 132)

More PLANT PROBLEMS

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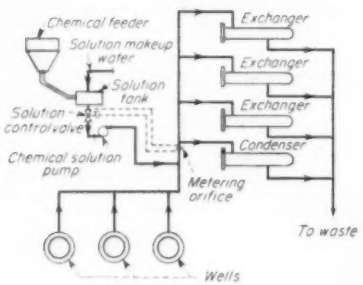

FIRST STEP in solving this problem is water analysis by a competent chemist. Type and concentrations of the chemical and physical constituents should be determined. These have a decided influence on corrosion and scale formation.

With once-through cooling, no water evaporation occurs in the usual industrial system because the temperature rise is not great enough. I assume *ST*'s system is this type. It's well-known that high temperatures increase the amount of oxygen liberated from the water, causing corrosion in ferrous and other metals used in heat exchangers, pipes and other equipment in industrial heat-transfer systems.

With alkaline water, the scale formed in once-through systems is chiefly calcium carbonate. Well water frequently has a high natural iron content. Iron oxide may be deposited from decomposition of ferrous bicarbonate. Low pH, oxygen and carbon dioxide cause corrosion in once-through installations.

It is important to determine how deposits form in cooling-water systems because this helps you distinguish between corrosion and scale formation. Generally, scale results from crystallization or precipitation of salts from solution. Washing away of metal is the result of corrosion. While both cause deposits, the mechanism of formation is different, as are corrective measures.

Temperature, rate of heat transfer, pH and concentration of calcium, magnesium, silica, sulfate, and alkalinity, all affect scale formation. However, in once-through systems, the magnesium, silica and sulfate concentrations are usually so low that they have little effect.

A chemist familiar with water treatment can determine if *ST*'s water is scale-forming. Materials having surface-active properties are helpful in preventing scale. Phosphates, tannins, lignins, starches, and a combination of these materials, increase the solubility of scale-forming salts. Normally, the addition of a few ppm of a surface-active agent to a water having a positive saturation index is sufficient to keep scale formation within acceptable limits. Of course, the agent must be fed proportionally. If the water has a high scale-forming potential, acid treatment or recarbonation may be needed to adjust the pH and alkalinity.

Oxygen is the main offender in corrosion of once-through cooling systems. It attacks ferrous metals, causing rust and pitting. Low pH resulting from carbon dioxide and sulfur dioxide may aid oxygen in causing corrosion. Water-temperature increase accelerates corrosion reactions.

Small pits or depressions usually accompany corrosion caused by oxygen. As the condition worsens, pit depth and area usually increase. An increase in pit depth resulting from corrosion is more detrimental than general metal wastage because metal thickness is reduced. This leads to a reduction of strength and possible ultimate failure.

A calcium carbonate scale on metal surfaces of once-through systems prevents corrosion. Surface-active corrosion inhibitors or elimination of corrosive oxygen in the water is usually suitable. But it is difficult to maintain a protective film on metal surfaces at low temperature when temperature rises occur in other parts of the system.

Surface-active phosphates, organics and silicates are common for reducing corrosion of ferrous metals. Economics usually limit treatment quantity to less than 10 ppm; this does not provide complete corrosion prevention. But using the right corrosion inhibitor gives protection of about 75%, compared to a system with no protection.

Vacuum deaerator is seldom practical in a system like *ST*'s because the high cost of the unit is difficult to justify for low-temperature low-pressure service.

Be sure to compare the cost of chemical injection with acid cleaning, if the latter will satisfactorily reduce corrosion effects. If chemical treatment is chosen, it is best to inject the chemicals at the source of the water supply so all the equipment will have the benefit of treated water.

Sketch shows one way of injecting chemicals into well water before it enters the heat exchangers. Solution feed is proportional to well-water flow. Flow nozzle or orifice in well-water line controls feed rate. Or an automatic proportioning pump may be used. Try to recover chemically-treated water as it leaves the heat exchangers. This will save money.

H B WAYNE *Brooklyn, N. Y.*

THRESHOLD TREATMENT, using vitreous or glassy phosphate to control corrosion, prevent lime scale and stabilize iron- or manganese-bearing waters, is a widespread industrial practice today. It is also used in higher concentrations for cleaning old wells to restore their pumping capacity and for the initial development of new wells to provide greater capacity at the start. For well cleaning, periodic treatment appears better than continuous because it is difficult to apply this treatment to a water-bearing stratum or well screen continuously. However, it has sometimes been done with feeder wells that surround the producing wells.

DON KELLAND *New York, N. Y.*

REMEMBER, continuous treatment keeps condensers and heat exchangers at peak efficiency at all times. With periodic cleaning, their efficiency decreases between the time cleaning ends and the time unit is taken out of service for another acid application.

Keep heat exchangers and condensers in good condition at all times because damage to tubes and shell and efficiency decreases can cost plenty in the long run.

C G HOWARTER *E. Peoria, Ill.*
L M MARTINEZ *Rego Park, N. Y.*
A A HUNNEWINKEL *Woodstock, Ill.*

EDITOR'S NOTE: *The above information was sent in by these three readers.*

(*Continued on page* 134)

For this month's two new questions turn to page 134

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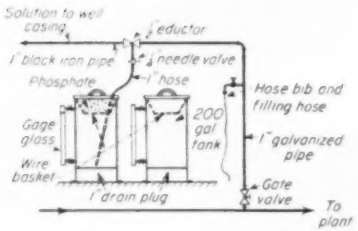
More PLANT PROBLEMS

Begins on page 130



WE FIND injection of phosphates helpful in reducing the effects of corrosion and high iron content in well water. Sketch shows how we hook up the treatment system.

Phosphate is injected directly into the well casing, after the solution is prepared in the tanks. One tank is for standby service. For treatment of our water we use 9.6 lb of phosphate per day. Water flow is 200 gpm. One batch of phosphate solution lasts about 50 days.

JOHN CONSTANCE
Cliffside Park, N. J.

PHOSPHATE COMPOUNDS effectively stabilize well water, eliminating scale deposits and corrosive attack. As these crystals dissolve, a thin glass-like protective film deposits to protect the metal.

Use an earthenware crock and stainless-steel basket to hold the phosphate while it is dissolving. Dosage, best fed with a pump, will vary with water demand but will average 2 to 3 ppm. Start treatment at 10 ppm, leaving system drains open until phosphate tests in all parts of the system.

Use a high-test hypochlorite because phosphate is food for bacterial growth. Use a water filter to eliminate rust, organic matter, discoloration and bad odors.

Phosphate reacts with compact hard scales to soften them so they crumble, loosening them from metal surfaces. Scale-removal rate increases with temperature and water velocity.

Periodic acid cleaning more than repays its cost. A typical heat exchanger cleaned with acid, by sandblasting and plugs and brushes, will have a far higher efficiency after acid cleaning than when any other method is used.

E W FITZPATRICK
Jefferson City, Mo.

INSTALL a continuous-treatment system, if possible. It will keep water in the right condition at all times during the year at low cost and with little trouble. I've found this method excellent for a similar job in my plant.

M B SHERIDAN *New York, N. Y.*

WE FIND that continuous treatment is better than intermittent acid cleaning because we can keep our heat exchangers in service at all times. This saves much production time and eliminates week-end labor crews we might have to use with intermittent cleaning.

The big factor to be considered in any cleaning job is how long the units will be out of service and what this means in dollars and cents. Of course, there are some units that are better cleaned with acid than by continuous feeding of chemicals. Much depends on the scale encountered.

I'd have a chemist analyze the water supply and go along with his recommendations for treatment. The results obtained should be apparent within a month or so because heat-exchanger efficiency can readily be checked on the job. Be sure you have thermometers on exchanger inlet and outlet so you see exactly how the unit is performing.

WILLIAM STERN *New York, N. Y.*

YOUR TWO NEW PROBLEMS FOR NOVEMBER

Question No. 1: What's Best Unit for Emergency Power?

Our large industrial plant produces typewriters. We buy our electricity, but a week ago there was a power failure that caused us plenty of trouble. Though this is the only one we've had so far, we'd like to be ready for the next, if it comes.

We figure that a 100-kw gasoline, diesel or steam-turbine unit would solve our problem.

Areas and units needing juice are: lights (exits, aisles, etc), sprinkler supply air, elevator, hospital, stokers, floodlights, fire alarm, auto-call system and cafeteria refrigeration units, fans.

Which drive would be best? How should we connect emergency unit into the system? Are there any other uses for emergency sets? What is the best type of control to insure good emergency power always?—*PT*

Question No. 2: What Causes Stack Carbon in Our Plant?

We burn No. 6 oil under our two hrt boilers serving a varnish and insulator factory. Boilers are in excellent condition and are regularly inspected.

However, we get many complaints from neighbors in the area about carbon flakes from our stack settling on their buildings and equipment. Our local smoke inspector has been in several times, will take action.

We've checked the boilers completely, including draft, CO_2 and stack temperature. All readings are OK, pointing to good combustion.

What causes this carbon to form? How can we reduce it? Is it possible to eliminate it entirely?—*HW*

Don't miss next month's two problems. Another chance to use your ingenuity

Will you help readers who sent us problems? Extra pay for photos or sketches.

PREVENTS PIPING "EMERGENCIES"

Wherever fluids are confined at high pressures and high temperatures . . . wherever lines are subject to vibration, weaving or severe thermal shock . . . wherever corrosive chemical conditions exist in the piping . . . there's a job for genuine Flexitallic Spiral-Wound Gaskets. Here is the original spiral-wound gasket made exclusively by Flexitallic since 1912. It compresses like a spring under bolting load and then rebounds when pressure is released. This amazing flexibility assures a permanently tight seal. It's a small cost to pay to prevent piping emergencies . . . Each Flexitallic Gasket is engineered for a specific sealing problem. Spirally wound V-crimped plies of required metal with alternating plies of proper filler result in a resilient gasket having characteristics of a calibrated spring. Flexitallic Gaskets are at highest efficiency when bolted up cold at a predetermined load. For all pressure/temperature ranges from vacuum to 10,000 lbs., from extreme sub-zero to 2000° F. For all standard joint assemblies. In four thicknesses for special requirements: .125", .175", .250", .285". With Teflon filler for corrosive chemical conditions. Write us your requirements . . . Flexitallic Gasket Company, 8th & Bailey Streets, Camden 2, New Jersey. Representatives in principal cities. Consult classified telephone directory.

40th ANNIVERSARY *Flexitallic*®

SPIRAL-WOUND GASKETS

FOR PIPE FLANGES, PRESSURE VESSELS AND PROCESS EQUIPMENT

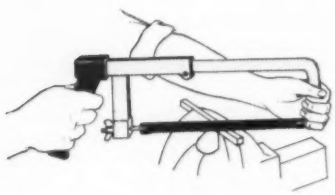
*Not all spiral-wound gaskets are Flexitallic. Look for the name FLEXITALLIC stamped into the metal spiral of every genuine Flexitallic Gasket. Look for *Flexitallic Blue* — it's our exclusive blue-dyed Canadian asbestos filler.

HOW TO

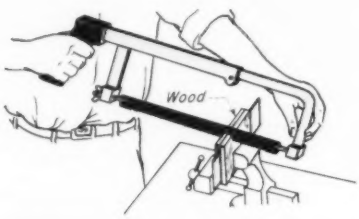
Handle Your Hacksaw

By SIDNEY V WORTH
New York, N. Y.

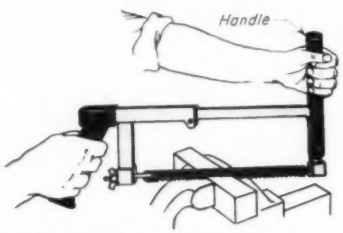
USED PROPERLY, the hacksaw is a useful, long-lasting tool. Secure blade firmly in rigid, nonbending frame. After use, protect sharpness by oiling teeth lightly



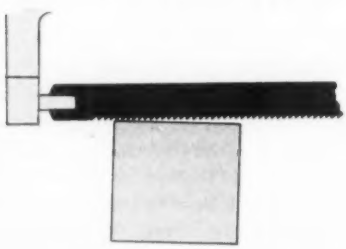
MOUNT BLADE with teeth pointing away from frame handle. Use long, smooth strokes. Lift blade slightly on return stroke. That prevents dragging teeth through material you cut, wearing teeth



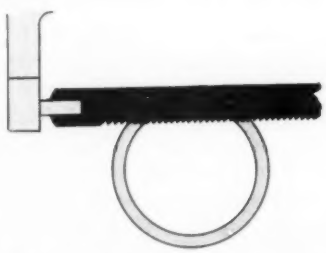
SANDWICH very thin stock between wood blocks. Then stock won't tear, and you can cut faster without harming saw blade. General rule is: Use blade of 32 teeth per in. for 1/16 in., or thinner stock



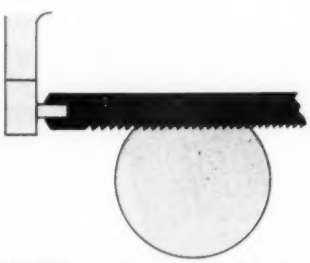
HEAVY STOCK takes greater pressure. Auxiliary handle, mounted on forward end of hacksaw frame, is useful. Slot a broom handle, drill and bolt to frame as shown. Keep this frame for heavy work



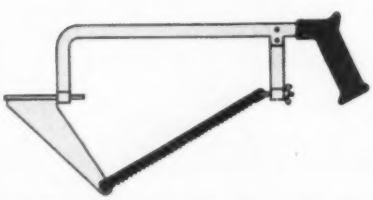
WHEN STARTING, reduce stroke angle to minimum so at least two or three teeth contact the work. Good cutting speed is 40 to 60 strokes per minute. But go slower and lighter on material that's softer



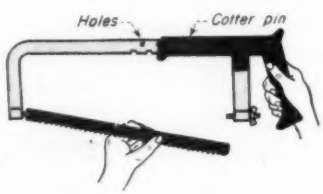
USE BLADE of 24 teeth per in. for metal of 1/16 to ¼ in. thick, on round, as here, or on straight stock. Use blade that has enough teeth so at least two teeth always contact thin material



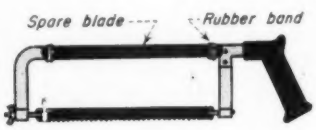
EIGHTEEN teeth per in. is good for general shop use. Stock over one in. thick, also softer materials, can take a 14-teeth-per-in. blade. Fine blades on thin stock prevent loading one tooth



TO MAKE cuts of any depth in thin material, use this special rig. Plate for the mounting blade is rigid enough to withstand pressure. Either rivet or weld plate to the long screw shown here



CHANGING BLADES is nuisance because frame tries to collapse. Drill holes in frame as shown. Lock frame with cotter pin for size blade usually used. If you change blade length, just move pin

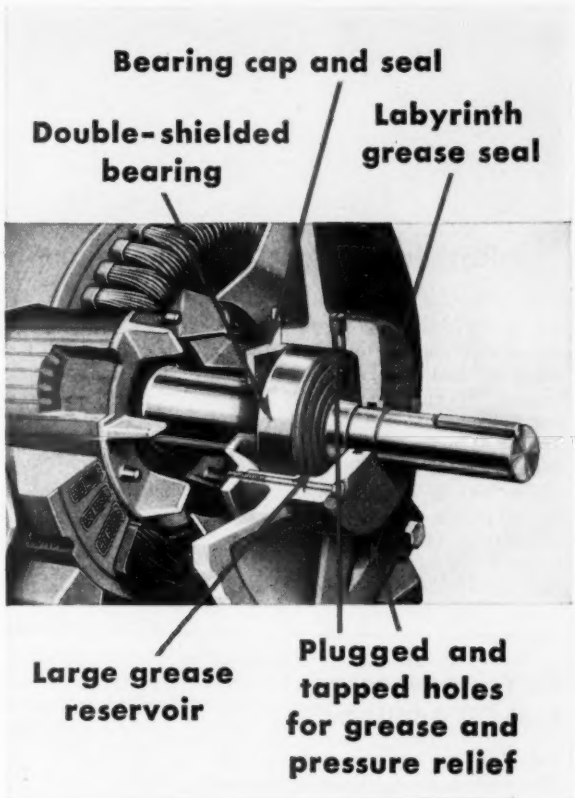


SPARE BLADES are handy to carry, fastened to frame as shown. Use rubber bands and slip enough blades under so you won't waste time running back and forth when supplies are at a distance

Here Are Facts You Should Know About Electric Motor Bearings

AN ideal motor bearing would operate for indefinitely long periods under all types of conditions without requiring any attention whatever. However, in the opinion of our engineers, such a bearing and its attendant lubricant are not yet available on the commercial market. Consequently, bearings for many types of operations, particularly where overloading, extreme temperature ranges and chemical and dirt laden atmospheres are involved, require special lubricants or regular lubrication schedules.

Of course, bearings suitable for many kinds of operation under normal conditions can be built to require no attention for very long periods — usually several years. Allis-Chalmers can supply sealed bearings in all frame sizes through 505 on short delivery and without extra cost for applications of this type.


Bearing cap and seal
Double-shielded bearing
Labyrinth grease seal
Large grease reservoir
Plugged and tapped holes for grease and pressure relief

Which is the Best Design for *Your* Application?

We believe that the design used in standard Allis-Chalmers drip-proof, tefc and explosion-proof motors represents the best design for most industrial users.

The Allis-Chalmers standard design consists of a pre-lubricated, double-shielded bearing mounted in the end housing with a generous grease reservoir. Plugged and tapped holes are provided for grease and for pressure relief. Under normal operating conditions, this design will operate as long without attention as any other type of bearing in use today. But where difficult operating conditions make re-lubrication desirable, it can be done as part of the normal lubricating routine without dismantling the motor.

The large grease reservoir and shielded bearing design assure that grease lost from the bearing due to high operating temperatures or other causes will be replaced automatically.

For further information on bearing design and other features of Allis-Chalmers motors, call your nearby Allis-Chalmers District Office or Authorized Distributor.

A-4147

ALLIS-CHALMERS

Milwaukee 1, Wisconsin

ARGUMENTS

Here's the place to unload your gripes to editors, manufacturers and fellow engineers

Rotatory Wonder Solves Farm Problems

BRITISH NEWSMEN describe this life-size, rustic machine as a "joyous and improbable attempt to achieve the impossible." And no wonder. It's Rowland Emett's "Hogmuddle Rotatory Niggler and Fidgeter," built by J E Slater, Ltd, Kibworth, Leicester, for Petters, Ltd, Staines, Middlesex. Emett, who is well-known both in England and the U. S. for his artistic genius, is the self-styled chairman of Improbable Railways.

Emett claims that this complicated machine will do all the work of a farm —from inducing eggs to filling out government forms. Here are some of its features, as reported by the British magazine, *The Engineer*.

Immediately behind the pylon supporting the 10-hp engine is a concurrent 4-stage baler. Next to it, an egg-inducer with X-ray attachment encourages egg laying by the resident hen. A rotary stook[1] drier and setter and an agromechanic's seat complete the first section of the niggler and fidgeter.

A hogmuddle free-flow arch joins the machine's two sections, and allows access for the local hunt, which might otherwise be disturbed by the length of the machine. Above the arch is a combined hedge trimmer and gentlemen's hairdresser, consisting mainly of three pairs of spring-operated scissors.

The secondary section contains a wurzle[2] digger, scrubber and polisher, embracing the fully automatic hog-muddle carrot rejector. Wurzles are dug by the 4-fork scrabbler, which removes them from the earth and impales them on prongs of the large ferris-wheel. Should a carrot inadvertently be dug, all rotary movement stops. The carrot is advanced slowly toward the rejector-trap, which leaps forward to receive it. Trap passes the carrot to the vibratory carrot-fuddler, which renders the carrot entirely harmless, except for the subsequent carrot-puree.

There is a control office, devised for taking care of most of the farm paper work. Government forms moving smartly on an endless belt are filled in, stamped and carefully disposed of quite painlessly as the machine is working, leaving the gentleman-farmer entirely free to enjoy the revolving featherbed.

Beneath the bed a rotary haystack is fed by a reversible hay lift that forms a useful method of supplying the farmer with refreshment.

[1]Stook: (British) A shock of corn
[2]Wurzle: A large coarse kind of beet, extensively grown in Europe as food for cattle

Do You Advocate Fuel-Oil Additives?

THE ARTICLE, "18 Diesel Q and A," May POWER, mentions use of lube oils with additives to fight sulfur. But it does not mention using additives in the fuel directly. Do you advocate their use, and have you ever tested any?

There are several on the market over here, and I understand that at least two German firms propose their use. Has any reader had experience with using additives directly in the fuel, and what have been the results?

R G MUELLER
St. Nom la Breteche, France

We Don't Need Earth-Leakage Trips

REGARDING this question of grounding techniques, September "Arguments," I was glad to note Whitaker's pertinent statement, "Our rules for grounding portable equipment . . . are based on conditions existing in the U. S."

From 1935 to 1938, I was in India where the earth-leakage breaker was being applied to local bungalow installations, mostly with only one 50-cycle ac circuit. These units operated at 22 v ± 2 v above ground with a 200-ohm resistance, and at less than 65 v with an 800-ohm resistance. The breakers were installed because using them was less expensive than arguing interminably with an authority.

But the manufacturers used no special grounding devices for portable tools, and there were no serious results.

I presume Hardy's system is nominally at 250 v, line to neutral. This requires care where local labor is concerned, since fatalities at less than 220 v were not uncommon during my sojourn in India.

During a 5-year period I kept a careful record of troubles for a group of public utilities in the U. S., extending from Maine to Florida and as far west as Michigan. There were only two occasions where poor grounding caused serious results.

If U. S. technique "is way behind current British practice," one wonders why the additional equipment would be justified here. A separate earth-leakage trip would be required for each portable-device circuit to localize the fault area, while with one grounded lead a fault is at once apparent.

C O VONDANNENBERG
Brooklyn, N. Y.

Right You Are . . .

IN "HARD SURFACING," March, page 115, Fig. 9 states that magnetic blow happens with ac. In welding shop I learned that "arc blow" occurs only with dc. What's the right answer?

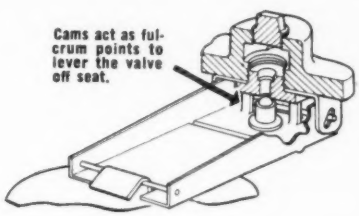
J S MILLER *Seattle, Wash.*

EDITOR'S NOTE: *You are right. We meant to say "If you have arc blow, correct by using ac."*

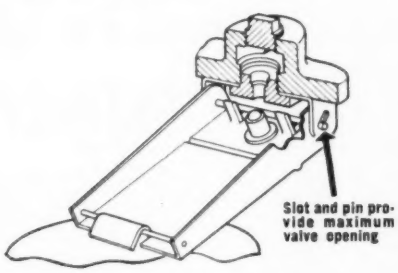
See how this NEW trap handles greater volume in less time

Yet it's small—gives you maximum capacity per dollar cost

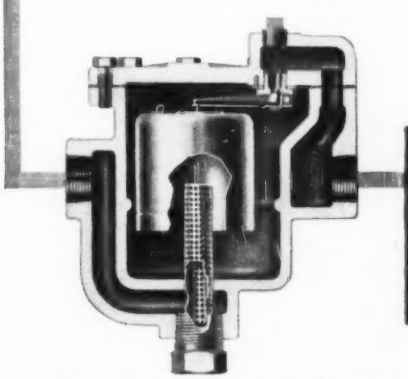
NEW SARCO
INVERTED BUCKET TRAP
with CAMLIFT valve mechanism

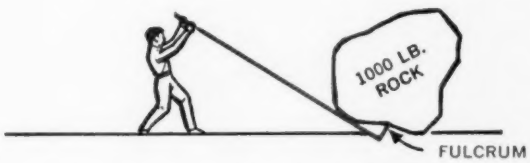


As bucket sinks CAMLIFT mechanism provides the powerful crowbar action needed to open large valve against steam pressure.

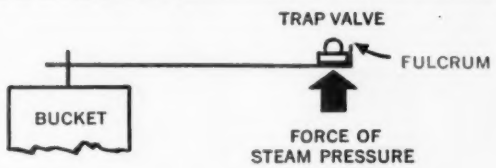


When steam pressure is overcome CAMLIFT mechanism drops to limit of slot, allowing rapid and free discharge of condensate.





MAN WITH CROWBAR MOVES 5 TIMES HIS WEIGHT



TRAP WITH *CAMLIFT* MECHANISM OPENS LARGE VALVE AGAINST MAXIMUM OPERATING PRESSURES

SARCO takes the principle of the fulcrum, incorporates it in its newly designed trap and gives you greater discharge with *no increase in trap size*. That means you get more for your steam trap dollar.

The Sarco *Camlift* valve mechanism makes this possible. It provides the powerful force needed to open the unusually large valve without a corresponding increase in trap size.

If you need a trap that's also rugged and simple in design, then we suggest you try this new Sarco Inverted Bucket Trap – in fact, we'd like to send you one for a free trial. We're confident you'll be convinced. Just clip the coupon and mail it in.

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Put this new inverted bucket trap to the test—see for yourself how to get more for your trap dollar.

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Gentlemen: Please send me a ½" Sarco Type B Bucket Trap for free trial. Maximum working pressure_____ psi; capacity_____ lbs/hr condensate.

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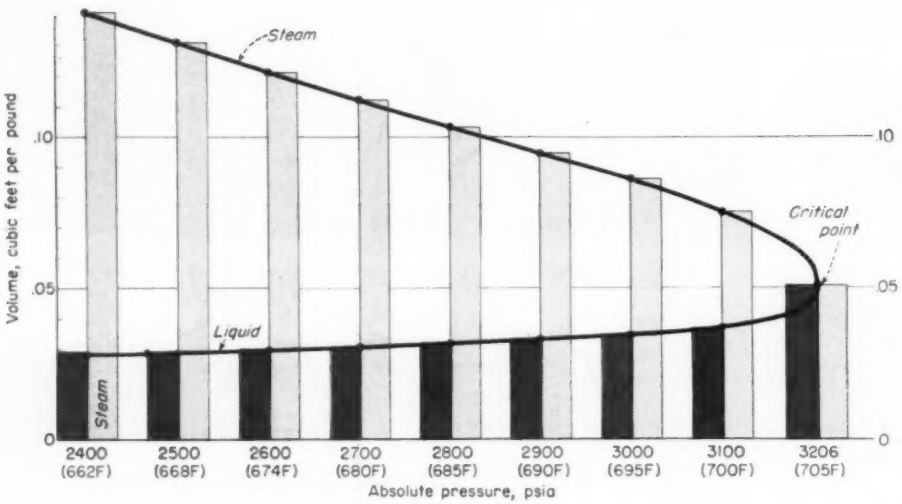
STEAM TRAPS • TEMPERATURE CONTROLS • STRAINERS • HEATING SPECIALTIES

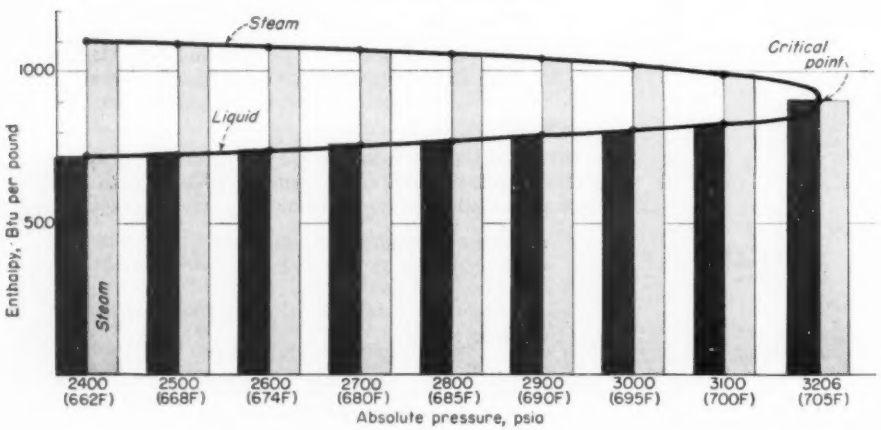
HEADWORK

PHIL SWAIN BRINGS ENGINEERING THEORY DOWN TO EARTH



VOLUME

As pressure rises, saturated liquid water gets lighter, while saturated steam gets heavier. At the critical pressure (3206 psia) both have the same volume (0.0503 cu ft per lb) and, in fact, *are* the same thing



ENTHALPY

As pressure rises, the enthalpy (heat added above water at 32 F) rises for saturated-liquid water, but falls for saturated steam until both become equal (903 Btu) at the critical pressure

The ABC of Superpressure—2

► FIRST, LET'S REVIEW a few fundamentals: For each pressure water boils at, there is a corresponding temperature called the *saturation temperature*. At this corresponding pressure and temperature both the steam and the liquid water are said to be *saturated*.

Saturation pressure and temperature rise together, but not in proportion, until the *critical point* is reached at 705 F and 3206 psia (lb per sq in. absolute).

Here (see curves), liquid and steam become exactly alike, so "liquid" changes to "vapor" without adding heat or increase in volume. That's why critical boilers can make steam without "boiling."

Above 705 F, water cannot exist as a liquid no matter how high the pressure.

At 60 F, one cubic foot of saturated water weighs 62.4 lb. At the critical point both the water and the steam will weigh 19.9 lb.

More information next month on critical pressure.

How we combat corrosion and searing arcs

In most industrial plants, metal-clad switchgear is under constant attack—inside and out. To protect against the effects of arcing, Westinghouse lines arc chutes with a true ceramic containing a high percentage of *zircon,* which has the highest melting point of any known material.

Additional important factors in chute life that maintenance men appreciate: Westinghouse chutes will not absorb moisture, have dielectric properties comparable to porcelain.

This switchgear employs the most effective method of arc extinction in use today. The arc is extinguished in split seconds and it is on the main contacts for only a fraction of this time. Result: less contact burning, less chute wear, less shock to the whole unit.

Bonderizing® best practical surface protection

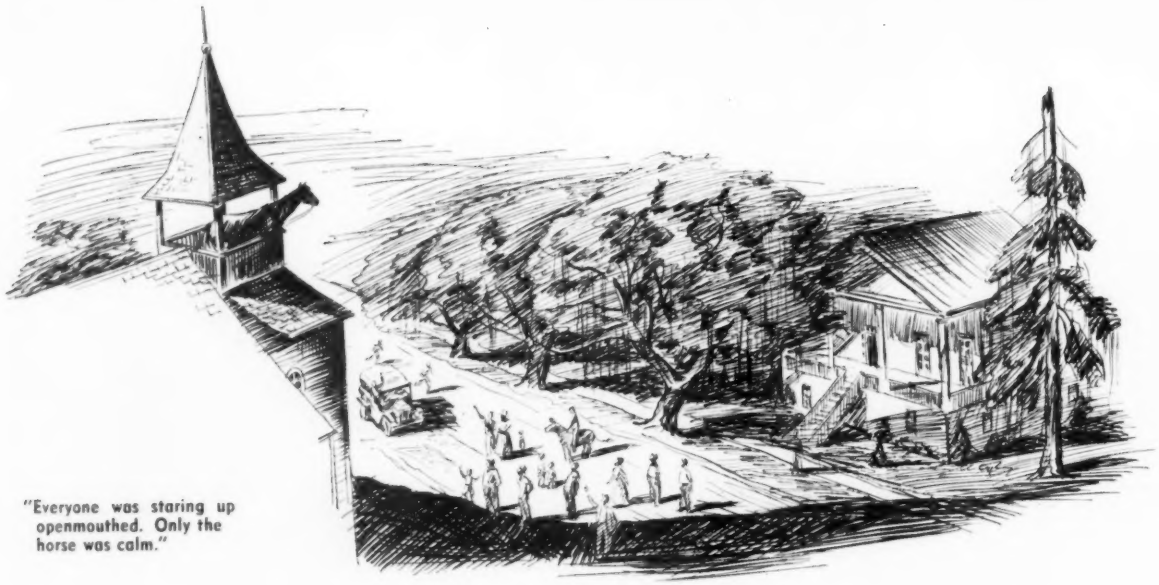
The best practical metal surface protection that we know of for switchgear is Bonderizing. We Bonderize our metal enclosures *after* they're assembled so that every nook and cranny gets the full five-dip treatment. Then the enclosures are painted twice and the paint sticks as though it is part of the metal.

In Westinghouse outdoor switchgear there's no worry about corrosion on the undersurfaces, either. After assembly, we spray them with a heavy layer of rubberized coating.

When you're planning switchgear installations, call in Westinghouse. And write now for your copy of booklet B-5306. Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.

J-60820-C

YOU CAN BE SURE...IF IT'S Westinghouse



"Everyone was staring up openmouthed. Only the horse was calm."

Marmy, A Horse and Compressors

► "ALL HELL broke loose in the quiet little town of St. Mary's, Georgia, one July morning in 1916."

That's what our photographer, Criss Grube, and I heard when we walked into the large sparkling engine room of the Schaefer Brewing Co in Brooklyn recently. The familiar foghorn voice came from the center of a dozen or so operators gathered around the chief engineer's desk.

Yep, that voice could belong to only Marmaduke Surfaceblow, consulting engineer extraordinary and an ex-marine and stationary engineer who had poked into every corner of this old world in his long, eventful and checkered life.

Criss and I were there to take photos (see pp 106-113) while chief engineer John Wolf had his steam turbine open for overhaul. But we didn't expect to run into Marmaduke. Peering through the crowd, I saw that Marmy had this situation well under control. There he sat, leaning back in the swivel chair, his size-16 canalboats propped up on the chief's desk. And he had a perfect strangle hold on a quart mug of cool lager beer—as did some of his audience. Here was the natural setting for Marmy, and he was in his glory.

Evidently this was not the time to take pictures, so I moved closer and listened. Marmy hoisted the mug and ballasted his tanks until the mug was empty. Then he gave his old gray bowler a starboard list, hooked his thumbs into the armpits of his checkered vest and blasted away.

"As I was saying, all hell broke loose that morning in St. Mary's, but let me tell you guys what I was doing in that dinky port in the first place. Three of us engineers from the *SS Caribbean* went ashore in Savannah one evening after pulling in from Havana. We burned up the town that night and next morning I awoke in the local hotel at St Mary's. Don't ask me how I got there. All I know is that I was stone broke.

"Walking down to the water-front, I came to the Pratt Refrigeration Co. A native told me that Joshua Pratt was the big shot in town. Fishermen brought their shrimp to his place for icing and shipping. That guy owned half the town and drove two of the finest horses in those parts.

"Pratt was in his office and asked me what in hell I wanted. When I told him I was a marine engineer, he laughed, then motioned for me to follow him into the plant. There I saw three 30-ton horizontal CO_2 compressors running at full speed.

"'You call yourself an engineer,' he cackled. 'Well, you got a job and we'll see how good you really are.' Then he explained that usually one or two compressors would carry the load, but that lately all three had to run. Trouble was the condenser was coated with paraffin. Seemed that old Joshua had tried to pinch pennies by using a paraffin-base oil in the compressors instead of the usual arctic oil.

"Pratt told me to hang up my coat and start rigging up a makeshift condenser from old piping so I could start cleaning the fouled up condenser soon as it was ready. His idea was to run the piping out into the bay and back. But I knew that was easier said than done.

"'I'll get that gunk out of those tubes without shutting down, tearing down, building a new condenser or opening one piece of equipment,' I promised.

"'How?' asked Joshua, suddenly swallowing his adam's apple and staring blankly at me.

"'By shutting off the cooling water to the condenser and getting the condenser so damn hot that all that paraffin will melt out,' was my answer.

"'Over my dead body,' wheezed Pratt. 'You ain't gonna burn up my expensive plant just to try a hair-brained theory. Operating refrigeration equipment calls for horse sense,' he added. And that was that.

"So I spent the day going through the motions of sizing up the place for the jury-rig condenser and scouting around for tools and equipment. 'You can kill a hog without breaking his legs and letting him bleed to death,' I always said, and I was going to do that condenser the easy way. In the meantime,

(*Continued on page* 208)

from Your *Nalco*® REPRESENTATIVE

● Nalco Representatives make friends and permanent Nalco System users with a simple formula: honest water treatment service.

You can ask your Nalco Representative questions and get straightforward answers . . . And if you stump him, he—and you—can put the whole Nalco Laboratories' and Service staffs to work on a plain-language plan of action to get you better water treatment results, most economically.

If you are not already getting the security from water treatment troubles that regular calls from your Nalco Representative bring, call or write today for prompt action.

Nalco WATER TECHS

A paper on "A Laboratory Method for the Study of Steam Condensate Corrosion Inhibitors," presented at the 8th Annual Conference, National Association of Corrosion Engineers, has been reprinted by Nalco for distribution to men interested in this problem. Your copy will be sent free upon request.

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THE *Nalco* SYSTEM . . . Serving Industry through Practical Applied Science

Making a *Workhorse*

JENKINS
Fig. 106-A
Renewable
Composition Disc
BRONZE GLOBE VALVE

150 lbs. Steam
300 lbs. O. W. G.

Industry's all-time favorite for long range economy

Take a Fig. 106-A apart. It's easy to see (and show) the reason why it's the "champion" of disc-equipped Bronze Globes. Every part, from heatproof handwheel to pipe ends, reflects the design and construction skill of generations of Jenkins Valve specialists.

Fig. 106-A not only looks better—it proves out better in performance. In any comparison, its long life, low upkeep record has never been surpassed. That is the true measure of valve cost—and it is the reason why industry's shrewdest buyers will settle for nothing less than Fig. 106-A quality.

a Champion

Why the *first* Renewable Composition Disc Globe Valve is still *first* with valve-wise buyers

Work horse of industry's pipelines is the renewable composition disc Bronze Globe. Because of the big demand, many versions of this valve are made. The buyer has a wide choice, and if he wants a valve that will just "get by" there are plenty of them.

Jenkins valve specialists have always taken a special view of this type of valve. It dates way back to the time when Jenkins introduced the *first* renewable composition disc Bronze Globe. In fact, Jenkins is still the only manufacturer of both valves *and* discs.

Jenkins engineers reasoned that the valve that has most of the work to do should have a liberal extra measure of dependability. The result is Fig. 106-A. It has all the rugged endurance of a work horse. But it also has the fine form, the lasting sensitivity of control—all the characteristic features of a champion.

That's why it is the leading choice of valve-wise buyers throughout industry. Try Jenkins Bronze Globes on your toughest services, for new installations, for all replacements. See why they are *your* best buy for lasting valve economy. Jenkins Bros., 100 Park Ave., New York 17.

GET THIS FOLDER— Gives details of Fig. 106-A design, and "family" interchangeability. Ask your Jenkins Distributor for Form 189-A, or write Jenkins Bros., 100 Park Ave., New York 17.

JENKINS VALVES

LOOK FOR THE DIAMOND MARK

SINCE 1864 — TRADE JENKINS MARK

Jenkins Bros

One Good Valve Becomes Another . . .

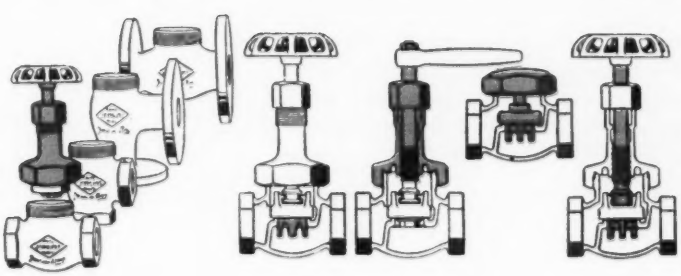


Fig. 106-A "Family" interchangeability meets 90% of Industrial Valve Needs. Trimming is interchangeable in Globe or Angle body, screwed or flanged. With a few parts, quickly assembled combinations provide a Lift Check, a Spring-loaded Check, and valves for Stop and Check, Quick-opening, or Throttling service.

Speaking of power

personal slants on doings of interest to power men—some significant, some just odd

This winter's oil outlook is good for users, not so good for producers. Stocks of crude and products are at record levels – so high, in fact, that some states have put limits on production and refiners are cutting runs to stills. Unless such cutbacks and heavy winter demands bite deep into stocks, lower prices are likely. In any case, there's no need to fear even local shortages.

Moose-locomotive collisions became so frequent after diesels went into service in the wilder sections of Canada that scientists were asked to investigate. The answer proved simple enough – moan of the diesel's horn sounds enough like a moose mating call to bring lovesick moose crashing into the engine.

Is your plant fire-safe? Disastrous fire at General Motors' modern transmission plant at Livonia, Mich., started a lot of self-questioning. Some big lessons from GM's experience: (1) Don't pin too much faith on apparently fireproof construction. (2) Make sure your plant-protection people are ready for an emergency. (3) Call in outside help promptly and train your fire forces to work closely with those of your community. (4) If your plant is a sprawling under-one-roof giant, give thought to dividing it into fireproof compartments.

A new fire-resistant paint was announced by a leading maker shortly after GM's fire. It's a water-reducible high-gloss enamel that will char under a blowtorch but won't burn. Using water avoids hazards of normal, highly flammable thinners.

U.S. generating capacity has passed the 100-million kw mark, according to Federal Power Commission. Big factor in boosting this total for utilities and industrials is the nearly 3-million kw added by utilities in first half of 1953.

Novel engineering ideas keep popping from the fertile brain of R G LeTourneau, dynamic pioneer in the earth-moving field. His latest is a rubber-tired freight train for rough, undeveloped country. The "locomotive" is a giant truck carrying a diesel-electric plant. Hitched to the locomotive are freight cars each having four powered wheels. Within the hubs of the heavily tired wheels are electric motors drawing juice from the locomotive power plant. The traction so gained permits the Tournatrain to climb steeper grades than an automobile.

An ingenious automatic steering system causes each car to follow exactly the path of the locomotive. If, for example, the locomotive makes a sharp turn, each car will come up to the same place and make an identical turn.

A new "Big Inch" to empty at Newark, N. J. is on the cards. Defense officials favor it to assure the East of supplies in event of war. Talks with prospective pipeline companies are expected to begin soon.

Heard a little jingle the other day that stuck in my memory. It goes like this:

The man who knows how will always have work
But the man who knows why will supervise the jerk

Not much as poetry – in fact, rather crude – but it makes a pile of sense.

Lou Rowley

These huge natural gas engines, about 40 to a room, drive the generators, furnishing all the electricity used by Alcoa to produce 170,000,000 pounds of aluminum in this plant yearly.

800 BOXCARS OF AIR

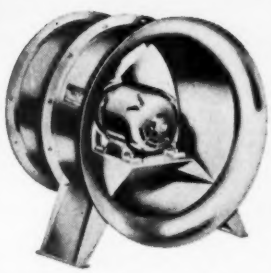
KEEP GENERATORS AT PEAK EFFICIENCY

Down at Point Comfort, Texas, a new kind of power plant was built a few years ago. 120 engines, running on natural gas, drive huge electric generators. Their job: to supply the current to smelt defense-needed aluminum. One of the biggest problems, though, was to keep the equipment running cool and thus at top efficiency.

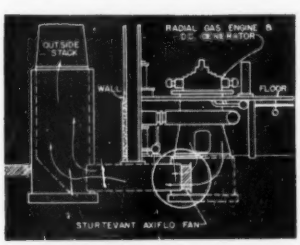
120 Westinghouse Axiflo® fans did the trick. Each draws 12,000 cubic feet of air through the generators every minute, picking up the excess heat. Then the air is piped through concrete ducts and out exhaust stacks which line both sides of the building.

Now Alcoa has just expanded this power plant. They have installed 74 new engines—and Westinghouse has supplied 74 more Axiflos. All in all, the 194 fans will move over 2,300,000 cubic feet of cooling air through the generators *every minute*. That's enough air to fill a trainload of 800 boxcars!

One day—today or in the near future—you may have a problem that involves *putting air to work*. When you do, remember that Westinghouse has the most complete air conditioning, air cleaning and air handling line in the industry. See the new Catalog 600. It contains 60 fact-filled pages on products, uses, and helpful data. To get your free copy, just call your local Westinghouse-Sturtevant office. Or, write to Westinghouse Electric Corporation, Sturtevant Division, Hyde Park, Boston 36, Mass.



Axiflo Fans keep them cool. They're compact, efficient, and trouble-free. That's important for hard-to-get-at jobs.



Cooling-air drawn through the engine generators picks up the intense heat, then safely exhausts it through individual stacks.

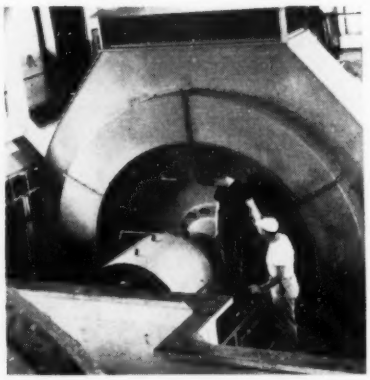
YOU CAN BE SURE... IF IT'S Westinghouse

J80281

AIR HANDLING

READER SERVICE SECTION

POWER NEWS_____148
TECHNICAL BRIEFS_____150
PLANT EQUIPMENT NEWS_____154
NEW FREE BULLETINS_____163



HYDRO-QUEBEC, world's largest hydraulic pipeline dredge, is clearing the entire 3300-ft width of the 15-mile Beauharnois Canal in Quebec. The 280-ft vessel displaces 2500 long tons. General Electric 8000-hp wound-rotor induction motor, shown at right, drives the dredge's single suction centrifugal pump that can lift and discharge 28-in. glacial bolders weighing up to 1500 lb. Giant 18-ft dia motor receives power directly from utility via 4000-ft cable laid on the bed of the canal

ISCC Urges Caution in Use of Unscientific Devices For Corrosion Prevention

► The Inter Society Corrosion Committee has become greatly concerned about hazards that may result from dependence on certain unproved devices for controlling corrosion and scaling. The Committee recommends extreme caution in the application of such devices, since any failure to give protection where a real problem of corrosion or scaling exists may result in serious damage to expensive equipment.

The above statement was issued by a subcommittee appointed by the Inter Society Corrosion Committee at its March 19th, 1953 meeting in Chicago.

ISCC consists of about thirty-five delegates from the major technical societies in the United States and Canada that are actively concerned with problems of corrosion control and with the scientific reduction of economic losses caused by corrosion. Through this word of caution and in accordance with its established objectives, the Committee seeks to promote use of the many scientifically sound and effective devices and processes presently available and to discourage dependence on unsound and ineffective methods of control.

The Committee wishes to draw particular notice to devices not based on any understandable scientific principle but usually promoted on the basis of testimonials—unsupported by quantitative data—from "satisfied" customers. The Committee calls special attention to supposedly scientific explanations making liberal and often incoherent use of high-sounding technical terms. These explanations, it claims, have no apparent basis in scientific fact.

In some cases manufacturers recom-

(*Continued on page* 256)

Donald C McGraw

Donald C McGraw Succeeds Brother As President of McGraw-Hill

► Donald C McGraw has succeeded his brother, the late Curtis W McGraw, as president of McGraw-Hill Publishing Co, Inc. The Board of Directors elected him president at a meeting held Sept 17.

The new president is the youngest son of the late James H McGraw Sr, founder of the company. He has been a director since 1935 and vice-president since 1945. During World War II he was a consultant to the Publishing and Printing Division of the War Production Board.

A native of Madison, N. J., Mr McGraw now is a resident of Summit, N. J. He is a graduate of Lawrenceville School and he attended Princeton University. During World War I, he served with the U. S. Navy.

Mr McGraw joined McGraw-Hill in 1919 as a member of the advertising staff of Chemical and Metallurgical Engineering, now Chemical Engineering. Two years later he transferred to the pressroom and composing room. Mc-

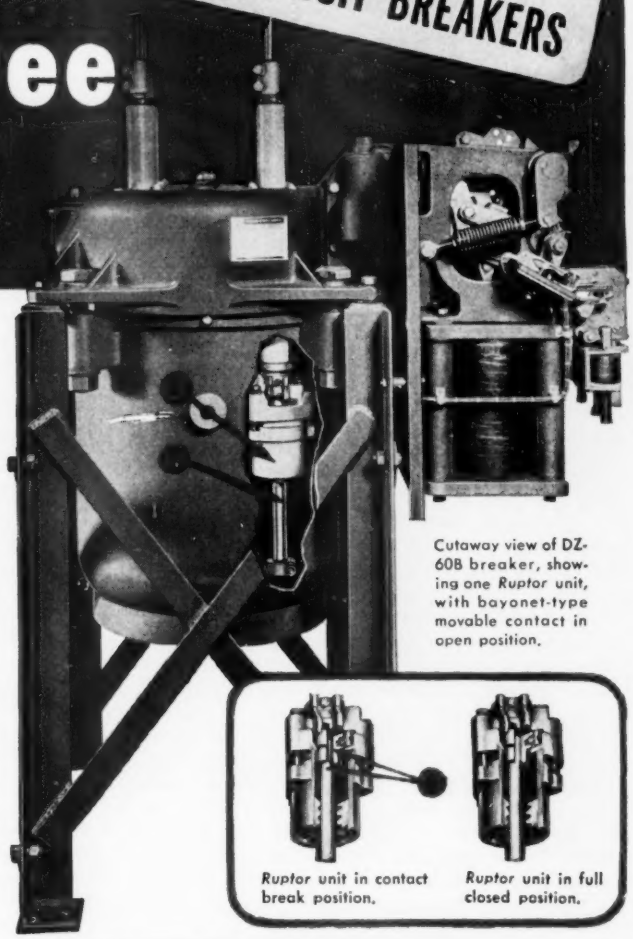
(*Continued on page* 256)

For coming events see page 256

Three Reasons Why

...Years of Trouble-Free Service

ALLIS-CHALMERS
Indoor
OIL CIRCUIT BREAKERS



Cutaway view of DZ-608 breaker, showing one *Ruptor* unit, with bayonet-type movable contact in open position.

Ruptor unit in contact break position.

Ruptor unit in full closed position.

One **Few moving parts!**

Bayonet contacts (1) are the only moving parts of the *Ruptor* interrupting device.

Two **Easy inspection!**

Drop the tank, and the bayonet contacts are visible in open position. For access to the stationary contacts, one needs only to remove four bolts and cylindrical shell (2).

Three **Self-aligning and Self-cleaning contacts!**

Tulip and bayonet contacts (3) maintain high conductivity without readjustment or cleaning. Arc energy is minimized by efficient interruption within oil-filled *Ruptor* unit. This in turn contributes to long contact life and low oil deterioration.

In addition, a mechanically trip-free solenoid operating mechanism controls contacts of time-proved *Ruptor* interrupting devices. And pole unit mechanism is self-lubricated — completely enclosed — sealed from dust, dirt, corrosion.

In brief, Allis-Chalmers DZ breakers are built to assure years of dependable, trouble-free service.

Allis-Chalmers power circuit breakers are available in ratings from 2.5 to 230 kv, with interrupting capacities from 15,000 to 10,000,000 kva, to meet all industrial and power company requirements. For more information, call your nearby A-C representative, or write to Allis-Chalmers, Milwaukee 1, Wisconsin.

A-4057

Ruptor is an Allis-Chalmers trademark.

TYPE	RATED KV	MINIMUM KV AT RATED KVA	RATED AMPS	KVA INT. CAPACITY
DZ-40B*	7.2	2.3	600	100,000
			1200	100,000
			2000	100,000
DZ-60B†	13.8	4.0	600	150,000
			1200	150,000
DZ-100B†	13.8	4.0	1200	250,000
DZ-200B†	13.8	6.6	1200	500,000
			2000	500,000

*Ask for Bulletin 71B6179. †Ask for Bulletin 71B6129.

ALLIS-CHALMERS

A-C ALLIS CHALMERS

TECHNICAL BRIEFS

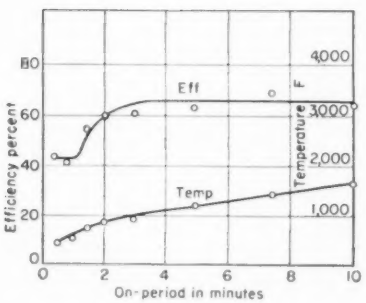
Latest engineering developments for busy power men

9 Digests for you on:
OIL BURNING
ENGINE PERFORMANCE
STACK DESIGN
PIPE FLOW

Characteristics of Residual Fuels 10 Domestic Refineries

Test	Max.	Min.	Normal Range	3 Middle East Refineries		
Gravity, °API	20	6	10–17	23	18	19–21
Specific Gravity	0.934	1.029	0.953–1.000	0.916	0.946	0.928–0.940
S. F. Vis 122 F, sec	280	20	50–180	50	25	25–35
S. U. Vis 100 F, sec	8800	300	1100–5100	1100	450	450–700
Redwood #1 Vis 100 F, sec	7800	265	980–4500	980	395	395–600
Pour Point, F	80	0	20–50	70	25	40–60
Conradson Carbon Residue, % Wt	15	1	5–12	9	5	6–7
Sulfur, % Wt	2.5	0.6	1–2	3.0	2.0	2.3–2.6
Ash, % Wt	0.33	0.01	0.02–0.11	0.07	0.01	0.02–0.04
Water and Sediment, % Vol	1.3	0.05	0.05–0.5	0.3	0.05	0.1–0.2
Sediment by Extraction, % Wt	0.55	0.05	0.1–0.3	0.05	0.05	0.05

1 Wide control limits preserve economic advantages but also make residual oil properties variable to the extent that tight specifications for use can not apply



2 Combustion chamber's refractory temperature will affect burner efficiency

Engineers Test Residual Fuels, Burner Efficiency

The Production and Utilization of Residual Fuels. *By R E Albright, C W Hofjman, C E Habermann, W F Hergrueter, Socony-Vacuum Oil Co.*

The nature and characteristics of residual fuel oils have become of increasing interest in recent years for marine diesels and in railroad and industrial gas turbine engines. This trend, based on the possibility of large savings in fuel costs, also extends into the field of industrial diesel engines. The present paper clarifies the types of products classified as residual fuels, provides specific information on present day product characteristics, and indicates the changes in product characteristics that may be expected as a result of changes in refining operations. Detailed information also covers some of the problems that may be expected in the use of heavy fuels in diesel applications.

Table 1 lists a few of the more well-known classifications established by large users and by industry groups in the United States for residual fuel for boiler use in industrial plants and on ships.

As this table shows, wide control limits preserve the economic advantages of using residual materials. Effectively, the classifications as listed are merely a means for segregating the lighter materials from the heavier stocks. Actually, a broad range in product characteristics can exist within each of these classifications. Of interest in respect to diesel engine use is (a) the absence of any limit on sulfur content, (b) the high allowable maximum values for water and sediment, and (c) the broad range of permissible viscosities. The fact that these and other similar classifications exist has led some consumers to believe that a given set of purchase specifications can be formulated for general use at different locations throughout the world. Unfortunately, this reasoning neglects the basic considerations underlying the production of residual fuels which result in wide variations in product characteristics. In this paper, the refining factors controlling these considerations are outlined in brief fashion. *ASME Paper No. 53-OGP-1.*

Combustion Efficiency vs Cycle Length of Domestic Oil Burners, *By J R Akerman, E A Farber and G L Larson, Univ of Wisconsin.*

This paper presents results of efficiency tests on specific oil burners and considers losses caused by combustible material in the stack gases, etc., not commonly accounted for. The efficiencies decrease, reach a minimum and then increase again with cycle length. This variation, when based upon combustion chamber surface temperature, can be accurately predicted—quantitatively as well as qualitatively.

An oil burner combustion efficiency is affected critically by the surface temperature of the combustion chamber refractory as shown in Figure 2, above. With the apparatus used in these studies, the efficiency is 42% when the surface temperature is under 950 F and 65% when it is above that temperature.

The length of the cycle does not affect directly the combustion efficiency. The cycles with an on-period of two minutes and an off-period of four minutes had an average efficiency of 60.59%, a figure somewhat higher than that for some of the longer cycles. This higher efficiency seems to result from the fact that the refractory does not have time to cool down during the four minute off-period. The cycles with an on-period of five minutes and an off-period of ten minutes had an average efficiency of 55.10%. This relatively low efficiency apparently is a result of the ten minute off-period being long enough for the refractory to cool down. But the five minute on-period is so short that a substantial part of the period is required for heating the refractory to the temperature required for efficient combustion. The cycles with an on-period of fifteen minutes had relatively high efficiencies, 63.51%, apparently because only a small part of the on-period is required for heating the refractory to the temperature required for good combustion.

The boiler water temperature also affects the combustion efficiency of an oil burner. With boiler water at the relatively cold temperature of 98 F, the

Trying to reduce piston packing maintenance?

J-M Pump Cups after removal from feed water pumps at Morgan Laundry. Set above consists of 2 J-M "A" Cups with spacer and 2 followers, mounted on pump rod

At the Morgan Laundry, J-M Moulded Packings provide

"8 times longer life— replacement in 1/6 the time"

THE MORGAN LAUNDRY, large supplier to hotels and institutions, requires dependable, trouble-free service from boiler room equipment. In their New York City plant, the Engineering Department found that conventional piston packings for boiler water feed pumps lasted only a relatively short time. Many hours of down time were required to replace packings. Liner wear became progressively worse.

When the Engineering Department changed from the conventional material to J-M Moulded Packing Cups, service life of the packing was increased more than 8 times. Liner wear was greatly reduced. Replacement with the new packings was made in 1/6 the time. Packings could be easily installed for proper service, without special skill or experience. Satisfaction with this application has led to the use of J-M Moulded Packing Cups on other boiler room equipment and on presses in the Morgan Laundry plant.

These precision moulded packings offer definite advantages over conventional types. Because they form a highly efficient seal, they contribute to improved performance, lower operating and maintenance costs. For steam pump pistons, they are available in sets consisting of two cups and two followers, with a spacer. This pump cup set, J-M Style 80, is similar to that shown in the illustration above.

Your Johns-Manville Packings Distributor can help you make the right selection for your application, from Johns-Manville's line of custom-made Piston Packing Cups. For complete details write him or Johns-Manville, Box 60, New York City 16. In Canada, 199 Bay Street, Toronto 1, Ontario.

JOHNS-MANVILLE JM PRODUCTS

Johns-Manville PACKINGS & GASKETS

More TECHNICAL BRIEFS

Begins on page 150

steady state efficiency of the apparatus used for this test was 60.0%. The efficiencies increase with boiler water temperatures up to a maximum of 67.9% at 142° F. Further increases in boiler water temperatures resulted in a drop in efficiency. The boiler water is the principal factor controlling the temperature of the crown sheet of the boiler, and the chilling effect of the crown sheet on the oil flame is, in our opinion, the cause of the lower efficiencies at the lower water temperatures. The drop in efficiency at the highest boiler water temperature is thought to result from the increased heat loss through the uninsulated outer surface of the boiler. *ASME Paper No. 53-F-20.*

Test Results of Medium Speed Engines on Heavy Fuels. *By Russell Pyles, Donald P Cryor, J M A Van der Horst, Van der Horst Corp of America.*

Heavy fuel use in the main propelling engines of ships has every indication of becoming general. Certainly it seems desirable from every angle that the auxiliary engines should be capable of operating on the same type of fuel.

The technical problems associated with heavy fuels in large, low-speed, main engines have had some years of development and study with such success that there are now close to 500 motorships operating on boiler fuels. The problems of the low-speed auxiliary engine (under 500 rpm) may be similar to many of those problems encountered in the large, low-speed, main engines, but as engine speeds increase, the old problems become more acute and new difficulties arise.

Higher speed auxiliary engines will be demanded because of increased power requirements, lighter weight and smaller space. Such engines, operating on regular diesel fuels, are already highly developed as typified by present-day locomotive and marine engines. The most desirable course would seem to be to adapt this type of engine to heavy fuels even though such a course involved development and design changes. *ASME Paper No. 53-OGP-6.*

Converting Waste Engine Exhaust Heat Into Energy. *By Robert C Coblentz, Coblentz Equip Co.*

An immeasurable source of untapped power is the millions of dollars worth of energy which constantly pours from engine exhaust stacks. Diesels, says the author, are tops in thermal efficiency and yet more than half the Btu's in the fuel is rejected to the jacket water or goes up the stack. A high percentage of this heat is recoverable and can be used to advantage. Waste heat recovery in the form of steam, hot water or air boosts overall Btu utilization. Today, through the development of a packaged unit, recovery in the form of refrigeration is possible, thus broadening the field of waste heat recovery application.

Such a packaged unit, now available to the diesel industry, is said to operate automatically at cost. It combines a waste heat boiler and a hermetically-sealed absorption refrigeration system, all mounted on one base.

A 4-cycle, 350-hp diesel engine operating at full load wastes enough heat through the exhaust gases to deliver ample heat units to operate a 25-ton absorption refrigeration unit, therefore packaged units are assembled in different sizes. These sizes range from a unit for a 350-hp engine with a 25-ton water chiller to a 3500-hp engine with a maximum of 250 tons of cooling. Larger units with variable refrigeration requirements can be assembled to meet specific requirements. *ASME Paper No. 53-OGP-5.*

A Photographic Study of Two-Cycle Gas Engine Cylinder. *By R L Boyer, D L Craig, Cooper-Bessemer Corp and C D Miller, Battelle Memorial Institute.*

The more important results from a two-year research program involving, it is believed, the first high-speed photographic records of events within a very large engine cylinder make up this paper. This cooperative research, by Cooper-Bessemer Corp and Battelle Memorial Institute, involved a Cooper-Bessemer GMV engine, a two-cycle, spark-ignited engine of 14-inch bore and 14-inch stroke, operating on natural gas. It is used widely for the pumping of natural gas through cross-country pipelines.

Schlieren photographs were taken of combustion, exhaust blowdown, scavenging, gas turbulence, and fuel injection, through large glass windows mounted at various positions in the cylinder head and cylinder wall. Slow-motion pictures made all of these phenomena clearly visible. Exact data were secured for all gas and flame velocities involved, as well as the crank-angles in these events.

The basic nature of flow of scavenging air through the cylinder volume in turbulent jets, which apparently cannot be circumvented, seemed the most valuable data obtained through this research program. *ASME Paper No. 53-S-45.*

Flame Temperatures in a Single Cylinder Spark-Ignition Engine. *By J H Potter and R B Dillaway, Univ of Illinois.*

Interest in flame temperature in the cylinders of internal combustion engines has brought to light many ingenious experimental techniques. Early workers used thermocouples or resistance thermometers of limited value because of thermal lag, mechanical instability, temperature damage and location.

In an electro-optical method worked out by Graff, radiation from alkaline salts in the working mixture in an engine-cylinder was focused on a photocell. The use of photographic filters narrowed the wave length band through which energy could be transmitted to the photocell. An amplifier and a cathode ray oscillograph were used, and the vertical deflection on the oscillograph pictures was calibrated in terms of temperature. This marked an important forward step as: 1) Individual cycles could be observed, 2) The whole cycle could be caught in a given photograph, 3) The maximum and minimum peak temperatures could be found, whereas the line reversal method gave an average of many cycles.

But the disadvantages of the Graff method were: 1) Difficulty in calibration, 2) Need for control of constancy of sodium concentration, 3) Relative complexity of the electronic equipment.

The present paper is built around experiments made on the engine generator set used by Hershey in which the Graff technique was employed. The

(*Continued on page* 236)

TO OBTAIN COMPLETE TEXT

Material for these abstracts comes from the following sources unless otherwise stated. Order complete paper from sources, not POWER.

American Society of Mechanical Engineers, Oil and Gas Power Div, annual conference, Hotel Schroeder, Milwaukee, Wis., May 25-28, 1953. Identified by initials ASME-OGP. Semiannual meeting, Statler Hotel, Los Angeles, Calif., June 28-July 2, 1953. Identified by initials ASME-S and obtainable through ASME, 29 W 39th St, New York 17, N. Y.

Air Pollution Control Assn, annual meeting, Lord Baltimore Hotel, Baltimore, Md., May 25-28, 1953. Identified by initials APCA and obtainable through R T Griebling, exec secy, APCA, 4400 Fifth Ave, Pittsburgh 13, Pa.

ANOTHER

American CRUSHER USER-REPORT

OVER 1,000,000 TONS ROM AND SCREENINGS, REDUCED TO 3/8" PRODUCT AT PARTS REPLACEMENT COST OF 1/4 CENT PER TON!

American 24-S Crusher installed 23 years ago for Acme Steel Co., Riverdale, Ill. Still in active daily use!

OPERATION REPORT ON AMERICAN CRUSHER

Description of product handled and reduction made.
Screenings to 3/8" (Coal)

What tonnage is handled on an annual basis? 40 to 50 Thou Tons #500 to $1000 per year

Estimate of annual Maintenance Labor on this crusher

We'd appreciate any comments you will give on the operation of this crusher It is a very satisfactory machine and has stood all the use and "ab-use" to which it was subjected.

Remember when the Graf Zeppelin made its history-making trip around the world? The year was 1929. It was in that same year that the American 24-S Crusher shown here was installed for the Acme Steel Co. of Riverdale, Ill. Many years have slipped by since then—but year after year this American has, in the words of the owner, "stood all the use and abuse to which it was subjected" in reducing ROM to a 3/8" product.

Proof-of-performance is now a matter of record—23 years of constant service for a total parts-replacement cost of $2702.35, or about 1/4¢ per ton of coal crushed!

Write for Coal Crusher Bulletins.

American PULVERIZER COMPANY

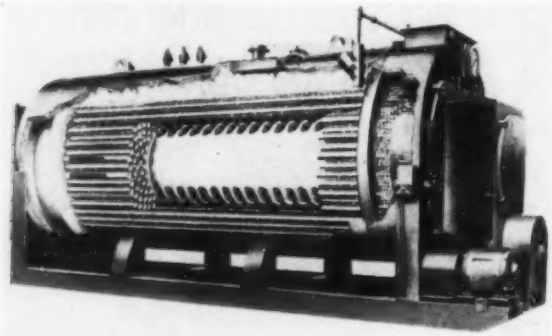
Originators and Manufacturers of Ring Crushers and Pulverizers

1349 Macklind Ave.
St. Louis 10, Mo.

PLANT EQUIPMENT NEWS

Your information center for new products designed to solve plant problems

Published monthly as a service to readers



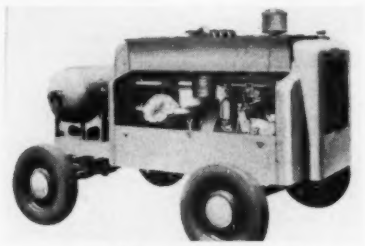
New Boiler Features Even Heating, Easy Maintenance

1100 • Automatic steam generator, 20 to 500 hp, features 2-pass design that eliminates need for refractory baffles or partition in front or rear. The simplified and improved *Continental* permits easy and full access to all fire surfaces. All tubes, by their arrangement, do an equal amount of work, since they are subjected to the same temperature. Two-pass design affords increased uniformity of longitudinal expansion, manufacturer claims.

Air enters furnace through tangential vanes around register located in furnace throat. Surrounding heated chamber for returning gas makes possible controlled mixture of fuel and heated air which, in combustion, creates a highly radiant flame with high rate of heat transfer.

From furnace tube, hot gases are forced with a spiralling motion through 3-in. return tubes to provide maximum heat transfer and low gas temperature at stack. Under normal conditions, stack temperature is guaranteed not to exceed 125 F above saturated steam temperature at operating pressure, according to manufacturer.

Boiler Engrg & Supply Co, Inc, Phoenixville, Pa.



Portable Compressor

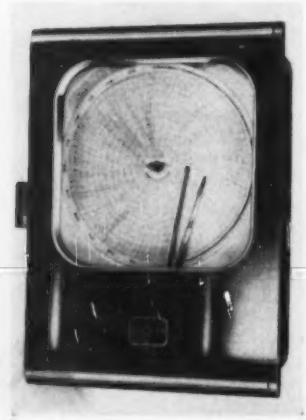
1110 • New 16 cfm portable compressor, *Super Chief 160,* features 2 and 4-wheel trailer and skid mountings and is reputed to be from 200 to 1000 lb lighter than other compressors of the same capacity. Unit has 2 low pressure cylinders with 6-in. bore and 3¾-in. stroke; one high pressure cylinder with 5¼-in. bore. It is offered in both gasoline and diesel-powered models.

Davey Compressor Co, Kent, Ohio

Pressure Relief Valves

1158 • New larger-sized pressure relief valves for hot water space heating boilers protect against over pressure. The new valves are called the 1-inch No. 230 and the 1½-inch No. 230. They are suitable for use on boilers with heat output to 743,400 Btu/hr and 1,025,100 Btu/hr, respectively; they open at 30 psi.

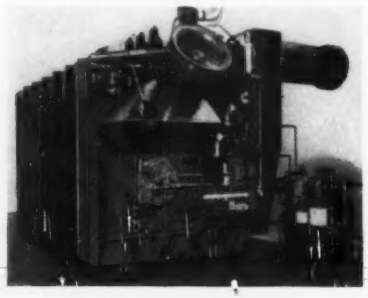
McDonnell & Miller, Inc, 3500 N Spaulding Ave, Chicago 18, Illinois



Electronic Controllers

1119 • New line of free-vane electronic controllers, part of *Series 500* line, use standard Bristol elements and are available for indicating or recording temperature, pressure, flow, liquid level, humidity and time program control. Combinations of one or two recording pens or indicators with one or two control units in one case make the new controllers adaptable to wide range of control problems. Bulletin B226.

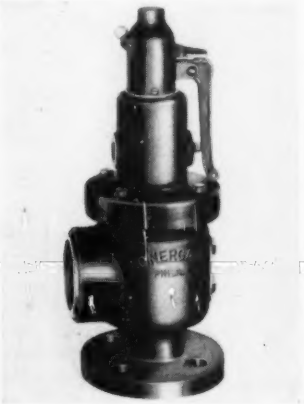
Bristol Co, Waterbury 20, Conn.



Package Boiler

1107 • New line of completely pre-assembled, water-tube steam generators, designated Type H, is available in 10 standard sizes from 8000 to 30,000-lbs steam per hr. Boiler has 2-drum design with vertical bent-tube arrangement and water-cooled furnace. Type H is fired by oil or gas and is adaptable to outdoor service. Heavy steel base functions as both skids and support. Free descriptive literature is available on request from manufacturer.

Bigelow Co, New Haven 3, Conn.



Safety-Relief Valve

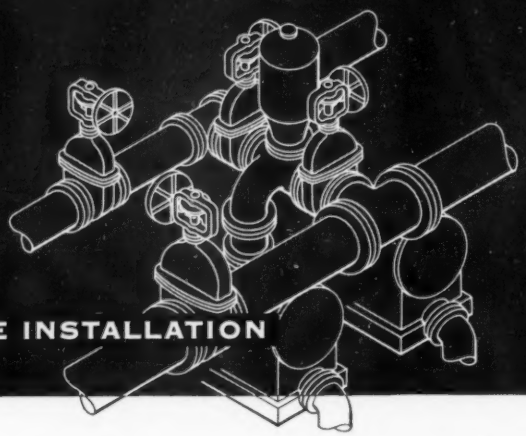
1132 • Improved safety-relief valve reportedly features higher capacity per size than any other valve, free-acting, self-aligning disc and a "floating" guide that assists opening and closing action. Disc and holder are of forged copper alloy. Unit is available in sizes from 1½ through 6 in.

J E Lonergan Co, 2nd & Race St, Philadelphia 6, Pennsylvania

(*Continued on page* 156)

For more data on these items, use post cards p. 163. Identify your request with item number.

These Valves Stay on Job After 50 Years of Water Service



THE INSTALLATION

At the Beaumont City Water Works, Beaumont, Texas, with Crane gear-operated iron body gate valves in main lines in pumping plant.

VALVE SERVICE RATINGS

SUITABILITY: *Always reliable*

FEATURES: *Rugged design in every part*

MAINTENANCE COST: *Routine care only*

SERVICE LIFE: *Still in service—since 1903*

OPERATING RESULTS: *No valve failures*

AVAILABILITY: *Crane Catalog item—Current No. 461*

THE CASE HISTORY

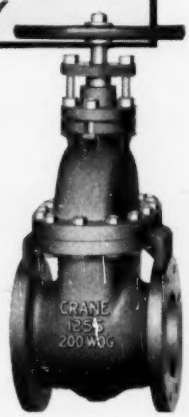
Beaumont taxpayers are still benefiting by the valve quality specified for the Municipal Pumping Station built in 1903. These 14, 16, and 24-inch Crane iron body gate valves remained in their original location until the old plant was converted recently from steam to diesel power. Even then, many were merely cleaned up and put right back in service in the new plant.

For 50 years and more, these Crane valves have given outstanding service at the lowest possible maintenance cost. With but routine care, they remained tight at seat and stem, and always performed with smooth, positive action, despite infrequent operation.

Here's an example of the quality that traditionally sets Crane apart from ordinary valves. It's value like this that has always made Crane the first choice of thrifty buyers in every industry.

THE VALVE

Today's Crane 125-Pound Iron Body Gate Valves with wedge disc are building equally outstanding service records. Highly engineered for durability and dependability at low cost, these valves are now available in the most complete line of patterns and sizes, with a choice of trim for water utilities and other services. Choose to your exact needs from your Crane Catalog, or see your Crane Representative.



THE BETTER QUALITY...BIGGER VALUE LINE...IN BRASS, STEEL, IRON

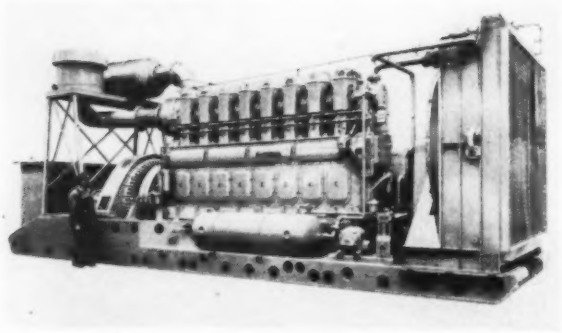
CRANE VALVES

CRANE CO., *General Offices:* 836 S. Michigan Ave., Chicago 5, Illinois
Branches and Wholesalers Serving All Industrial Areas

VALVES • FITTINGS • PIPE • PLUMBING • HEATING

More EQUIPMENT NEWS

Begins on page 154

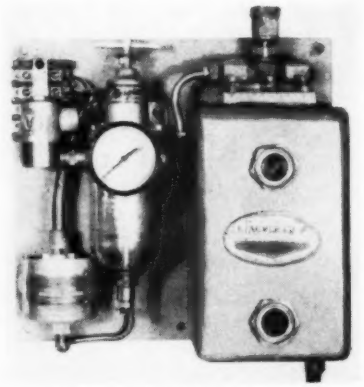


Portable Diesel Generator Is Completely Self-Contained

1103 • New 1000-kw diesel generator shown above is one of several now generating electrical power at remote points. Unit is wholly self-contained on skid mount. Fuel tanks, cooling radiator, control panel and all necessary gear are mounted on common skid. Manufacturer claims unit can be ocean or trailer transported and be ready for use on arrival.

Largest of these power plants is 35 ft in overall length. Smaller units in the 100 to 500-kw range are 10 feet overall. Weights range from 5½ to 22½ tons. Recommended uses are in dam construction, power for air field clearing, emergency power in distress areas, pumping large volumes by either direct drive or with generated power and supplying power for all types of construction equipment.

Enterprise Engine & Machy Co, 18th & Florida St, San Francisco 10, California



Automatic Oiling System

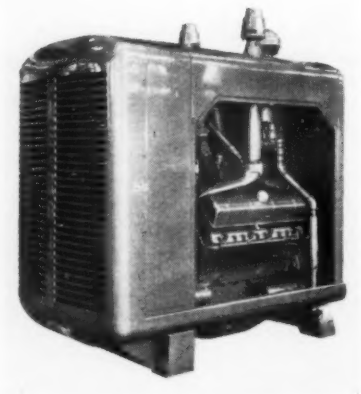
1134 • Fully automatic oiling system for plain bearings, ball and roller bearings, vees, slides, ways, rollers, cams, chains, gears and transmissions applies constant and uniform oil film to groups of bearings. System has no moving parts—operates solely on compressed air by atomizing oil for distribution in air stream through tubes to bearings. Amount of oil flow is adjustable. System can be installed to deliver oil at any point, manufacturer claims.

J N Fauver Co, Inc, 51 W Hancock, Detroit 1, Michigan

Lubrication System

1131 • Automatic precision lubrication system, *Lo-Flo Lubricator*, reportedly delivers minute quantities of lubricant to as many as 36 individual points regardless of pressure differences. It is available in 18 or 36 feed models with or without group regulation of feeds. Device has flow rate per feed ranging from 2.3 cu in./hr to less than 1 cu in./700 hr and can use a variety of lubricants from light oils to light grease at 60 F. Manufacturer claims working pressure of 500 psi and relief of 1000 psi are sufficient to overcome line blocks.

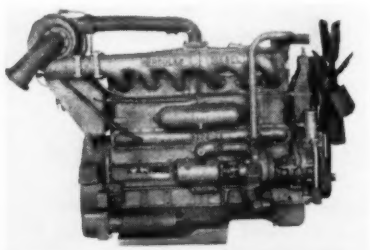
Nathan Mfg Corp, 416 E 106th St, New York 29, New York



V8 Industrial Engine

1105 • New 844 cu in., valve-in-head, V8 industrial engine gives continuous heavy-duty service over wide range of speeds up to 2000 rpm. The above unit, H844, features removable wet-type cylinder sleeves, cam-ground aluminum pistons, gear-driven water pump, extra heavy counterbalanced crankshaft, full-pressure lubrication and water-cooled manifolds. It reportedly develops 210 hp at 2000 rpm and can be equipped to burn natural gas, butane-propane or gasoline. Manufacturer recommends engine for well-drilling and irrigation.

Le Roi Co, 1706 S 68th St, Milwaukee 14, Wisconsin



Turbo-Supercharged Diesel

1111 • New diesel engine, Model DFXE-TS, fulfills demand for more hp without increasing fan-to-flywheel length, manufacturer claims. Engine has 5⅝-in. bore x 6-in. stroke and 895-cu in. displacement; develops 846-lb ft torque at 1800 rpm and 318 hp at 2000 rpm. Supercharger is exhaust-driven.

Hercules Motors Corp, Canton, Ohio

Rate-Of-Rise Thermostat

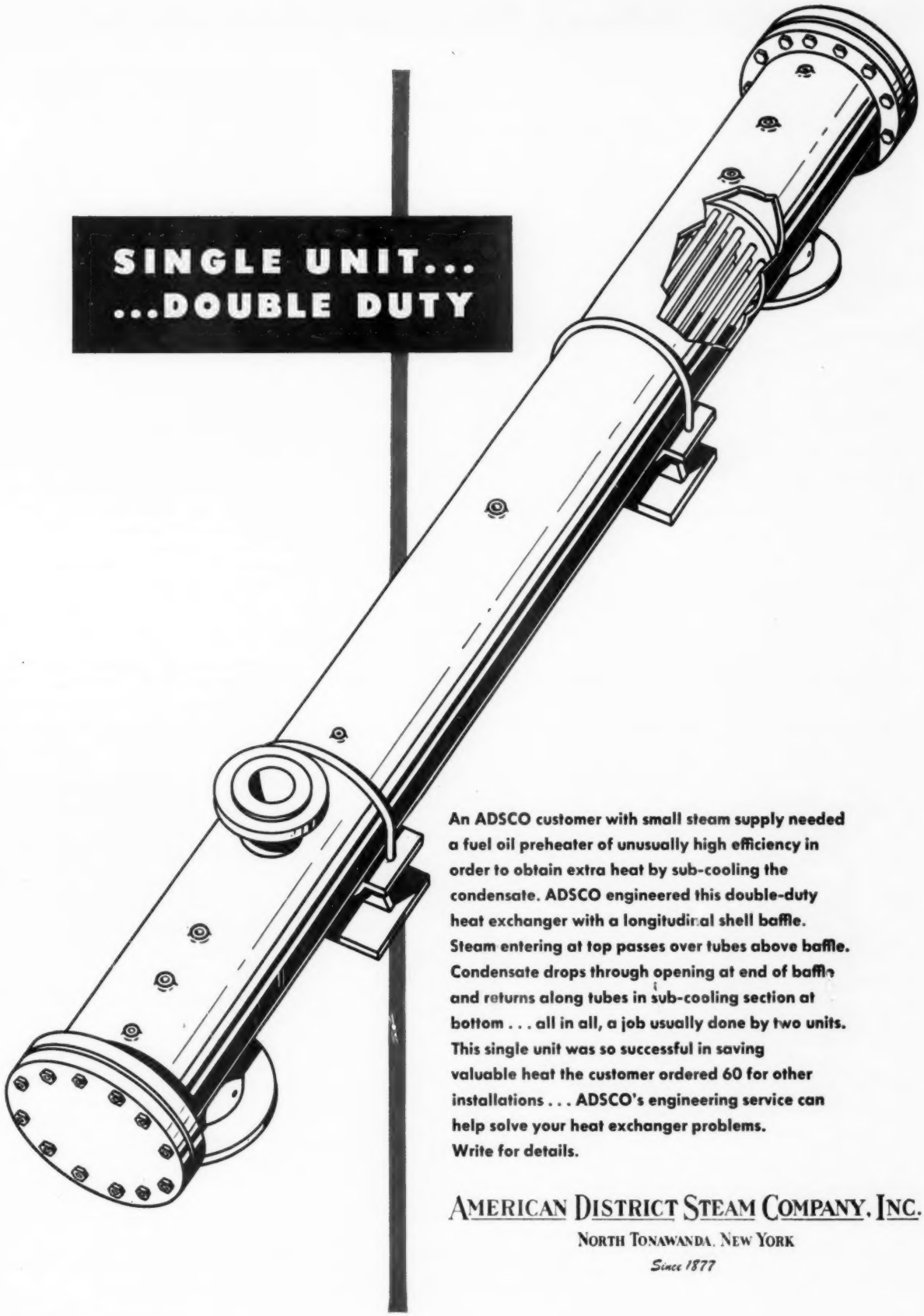
1149 • New rate-of-rise thermostat controls rate of heating and prevents hazardous temperature overshoots in fast warm-up systems. Unit is useful in any type of system and controls heat output during warm-up period then aids in bringing system up to desired temperature without danger of overshooting. Thermostat may be used with either standard temperature controls or as a separated safety control. Device is shock and vibration resistant and operates in ambient temperature range between −100 and 550 F. Write manufacturer for details.

Fenwal, Inc, Ashland, Massachusetts

(*Continued on page* 158)

For more data on these items, use post cards p. 163. Identify your request with item number.

SINGLE UNIT...
...DOUBLE DUTY



An ADSCO customer with small steam supply needed a fuel oil preheater of unusually high efficiency in order to obtain extra heat by sub-cooling the condensate. ADSCO engineered this double-duty heat exchanger with a longitudinal shell baffle. Steam entering at top passes over tubes above baffle. Condensate drops through opening at end of baffle and returns along tubes in sub-cooling section at bottom . . . all in all, a job usually done by two units. This single unit was so successful in saving valuable heat the customer ordered 60 for other installations . . . ADSCO's engineering service can help solve your heat exchanger problems. Write for details.

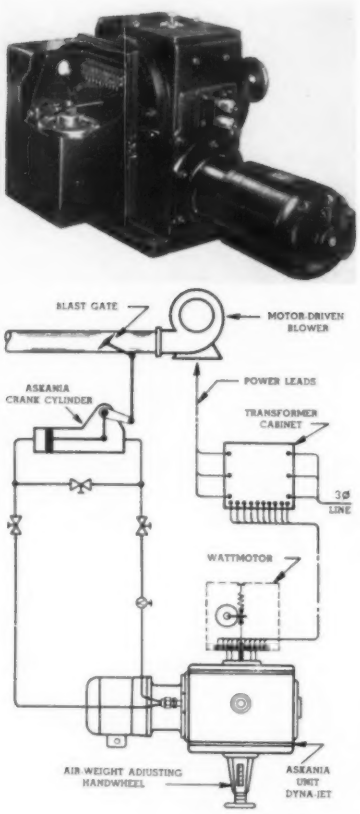
AMERICAN DISTRICT STEAM COMPANY, INC.

NORTH TONAWANDA, NEW YORK

Since 1877

More EQUIPMENT NEWS

Begins on page 154



New System Provides Constant Air-Weight Control

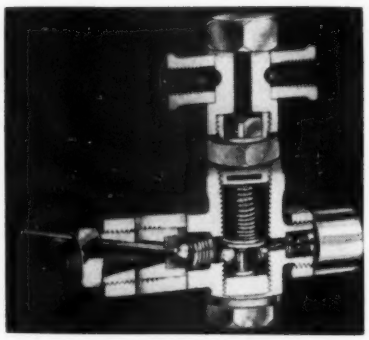
1137 • New control system, for use where power input is convenient measure of other variables, provides constant air-weight control with motor-driven cupola blowers. *Dyna-Jet*, the jet pipe regulator, comes equipped with special power-responsive signal system.

Unit furnishes air-weight control based on the principle that air-weight delivered by a motor-driven blower is directly proportional to power consumed. Unit measures 3-phase power and puts out a high-level hydraulic signal in proportion to deviation from pre-set power level. This force works on a two-way hydraulic cylinder to position blast gate.

System operates with conventional instrument transformers with 120-v and 5-a secondaries. Motor potentials up to 2400 and currents up to 800 a can be used with suitable voltage and current transformers.

Manufacturer claims installation is simple and cost is low because there need be no change or addition to existing piping. A handwheel scale calibrated directly in units of air-weight delivery permits easy adjustments. System is self-lubricating and easy to maintain; its only moving part, the jet pipe relay, is bathed in oil. Bulletin 158 is available on request from manufacturer.

Askania Regulator Co, 240 E Ontario St, Chicago 11, Illinois



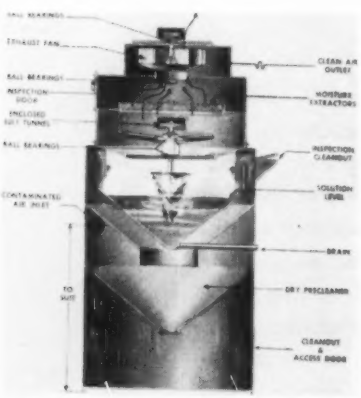
Wobble-Rod Air Valve

1112 • All-metal construction, flexibility of both mounting and application, *wobble-rod* action and integral exhaust of new valve offer new possibilities to designers and users of pneumatically-operated equipment. Hardened rod that actuates valve can move in any direction. Internal exhaust valve will automatically discharge when valve closes but can be eliminated if line pressures must be held. Check valve ahead of the ball and seat prevents backsurge.

Valve has no rubber or fiber seats or diaphragms. All parts are of bronze, brass and stainless steel. Dissimilar metals are used at all friction points to prevent galling. Overall dimensions are 3⅛x5x4⅝ in.; weight is 2¼ lb; maximum operating pressure is 125 psig.

Pantex Mfg Co, 521 Roosevelt Ave, Pawtucket, Rhode Island

For more data on these items, use post cards p. 163. Identify your request with item number.



Dust and Fume Eliminators

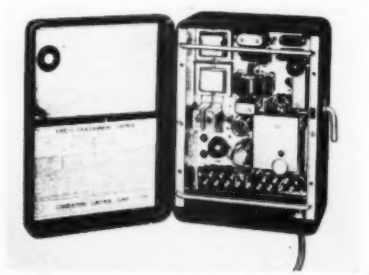
1135 • *Centri-Merge* vertical rotor wet type dust and fume eliminators are available in two unit types. One unit is for wet collection and elmination only, while the other is a combination primary dry and secondary wet collection unit. Both units combine the cyclonic principle of dust separation and positive high pressure water action to remove impurities from air. Capacities range from 500 to 50,000 cfm.

Schmieg Industries, Inc, Detroit 2, Michigan

Precision Tempswitch

1128 • *Tempswitch* No. 3-C1200 provides accurate control where conditions require snap action of contacts. Small assembly, 2½x1 in., lends itself to applications with limited space. Principle of operation is thermo-sensitive liquid in case; as temperature increases, plunger actuates direct and reverse acting switch. Capacities range from 70 to 150 F standard with others up to 300 F. Switch is UL-approved.

Smith Control & Instrument Co, Inc, Palmyra, New Jersey



Programming Control

1104 • *Fireye* programming control provides full protection against costly flame failure explosions in addition to programming for any application requirement for commercial-industrial gas, oil or combination burners. Employing flame-sensitive *Firetron* cell, device shuts off fuel in 2 to 4 seconds after burner flame goes out.

Fail-safe circuit prevents operation under any unsafe condition. Plug-in chassis provides maximum accessibility and ease of installation. Unit is said to withstand vibration and to give continuous performance under the most adverse conditions.

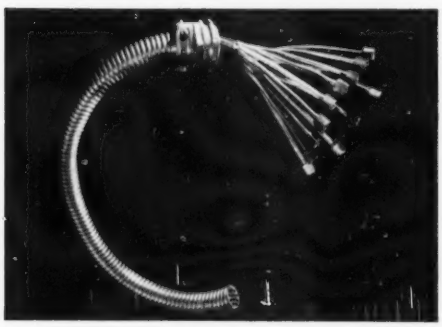
Combustion Control Corp, Dept N, 718 Beacon St, Boston 15, Mass.

(*Continued on page* 160)

For the new pneumatic instrumentation

Cabled Tube

The recent tremendous increase in the use of tube instead of wires for instrumentation and control purposes has led to an important new development—cabled tube. This is an armored group of long tubes twisted together to permit bending without distortion. An insulating tape is wrapped over the bundle of tubes to prevent electrolytic action. Then interlocking, flexible galvanized steel armor is applied, like BX. This protects the tubes from injury during shipment, storage, installation, and in service. Standard fittings, boxes and cabinets can be used for junction boxes and terminations. To make it possible to readily identify each tube, one tube in each layer is colored; the position of each tube in each layer in relation to the coded tube

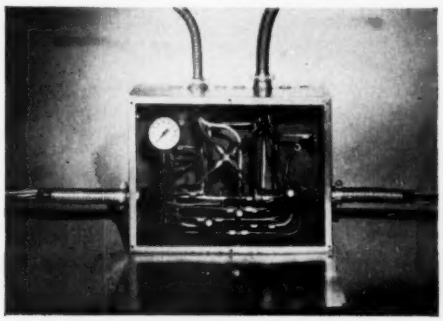


remains the same throughout the length of the cable.

The tubes usually are copper, but aluminum tubes can be used for special purposes. For unusually corrosive situations, a plastic outer sheath can be applied. As many as 19 tubes, ¼" OD, can be cabled, and supplied in lengths up to 1,000 ft.

Showing the construction of Crescent Armored Multitube, made by Crescent Insulated Wire and Cable Co., Trenton 5, N. J., which will supply further information on request.

Since the tubes carry not electricity but air, nitrogen, helium, or a fluid, they are especially attractive in potentially explosive locations, as in refineries and chemical plants. Utilities are also turning decisively to this new cable, while automatic process control (automation) is a rising application.



Revere, as a supplier of tube for this purpose, calls this cabled tube development to your attention as a matter of general and perhaps specific interest. See Revere for copper, aluminum and brass tube and pipe, electric welded steel tube, and lockseam tube. Call the nearest Sales Office.

REVERE

COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

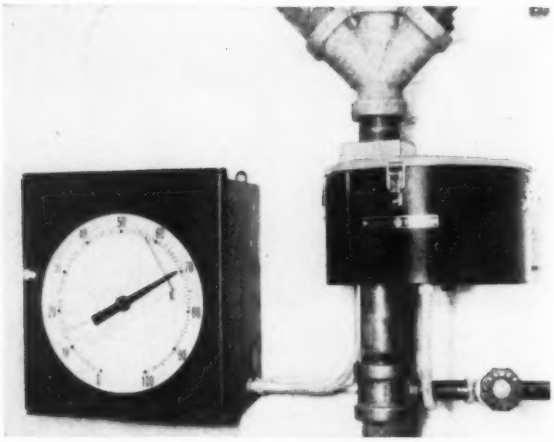
230 Park Avenue, New York 17, New York

Mills: Baltimore, Md.; Chicago and Clinton, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Rome, N. Y. Sales Offices in Principal Cities, Distributors Everywhere

"MEET THE PRESS" ON NBC TELEVISION, SUNDAYS

More EQUIPMENT NEWS

Begins on page 154



Turbidimeter Records Particle Suspension in Moving Liquids

1102 • Recording turbidimeter continuously and automatically measures and permanently records number of particles suspended in liquids. Developed for use in any process where turbidity is significant, device is adjustable over a wide turbidity range. It provides readily available measurements for monitoring and controlling and can be used with audible or visible alarm.

Specific applications include: private water supplies feeding processes that may be affected by turbidity, monitoring of wastes dumped into streams to guard against pollution, water treatment plants where turbidity of incoming water determines amount of flocculation chemicals needed and any process in which filter effectiveness must be monitored continuously and accurately.

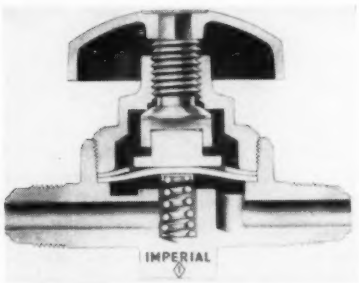
Device is based on the principle that suspended particles will scatter light passed through a liquid. A photovoltaic cell, the unit's detecting element, picks up scattered light and then pure light alternately and the computed ratio determines degree of turbidity.

Manufacturer claims system is quite stable with respect to variations in photocell sensitivity, temperature, lamp brightness, line voltage and color of liquid. Maximum operating pressure inside sampling head is 100 psi. Unit has accuracy of ± 5% of full scale and precision of ± 3% of full scale. Cycle time is 60 seconds.

General Electric Co, Schenectady 5, New York

CHECK THESE TOO!...

Air Release Valve . . . . . p 170
Electronic Flow Meter . . . . . p 174
Cemented Stator Windings . . . . . p 178
Multirange Transformer . . . . . p 182
Combination Truck . . . . . p 186
Safety Hooks . . . . . p 190
Engine Preheaters . . . . . p 194
Heat Machine Panels . . . . . p 196
Industrial Wipers . . . . . p 200



Packless Shut-off Valve

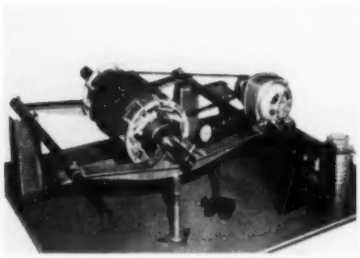
1129 • New packless shut-off valve with solid *Teflon* diaphragm is reportedly suited to vacuum applications, instrumentation, processing, pneumatic service, etc. Manufacturer claims soft seat allows positive shut-off with finger-tip operation. Diaphragm resists all liquids and gases except fluorine, chlorine trifluoride and molten alkali metals. Temperature range is –100 to 450 F; pressures up to 300 psi. Bulletin 3021 available from manufacturer.

Imperial Brass Mfg Co, 1200 W Harrison St, Chicago 7, Illinois

Vacuum Gauge

1122 • New vacuum gauge features switching unit that permits monitoring of as many as five positions in a vacuum system. Modified unit employs one-knob switch that permits a single operator to make selective readings at any of five stations. This allows processing plants to establish economic permanent multiple-point systems for measuring in the low micron range. Range of gauge is from 1 to 1000 microns Hg.

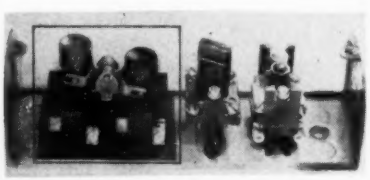
Hastings Instrument Company, Inc, Hampton, Virginia



Balancing Machine

1159 • Recently introduced at NISA convention, *Plane-Lock* balancing machine utilizes basic principles of harmonics. Unit enables any size motor shop to do a precision balance job on rotors, impellers, armatures, blowers, fans, etc. Machine is available in three separate models for particular purpose of job. Because of its specialized nature, it is currently being manufactured in only limited quantities.

Brownell Distributors, Inc, 306 Canal St, New York 13, N. Y.



Heavy Duty Pushbutton

1118 • New heavy duty pushbutton consists of two 2-point units—each with one normally open and one normally closed contact—in a permanent assembly. Snap-action over-center toggle mechanically interlocks buttons and provides positive action—when one button is up, the other is always down. Basically a 4-point unit, pushbutton's continuous and interrupting ampere rating is the same as a standard 2-point unit: 10-a continuous, 50-a maximum interrupting at 110-v ac and 2-a maximum interrupting at 125-v dc. With proper connections, pushbutton can be used for 3-point applications; or, it can be used for 2-point service by applying only half of the unit.

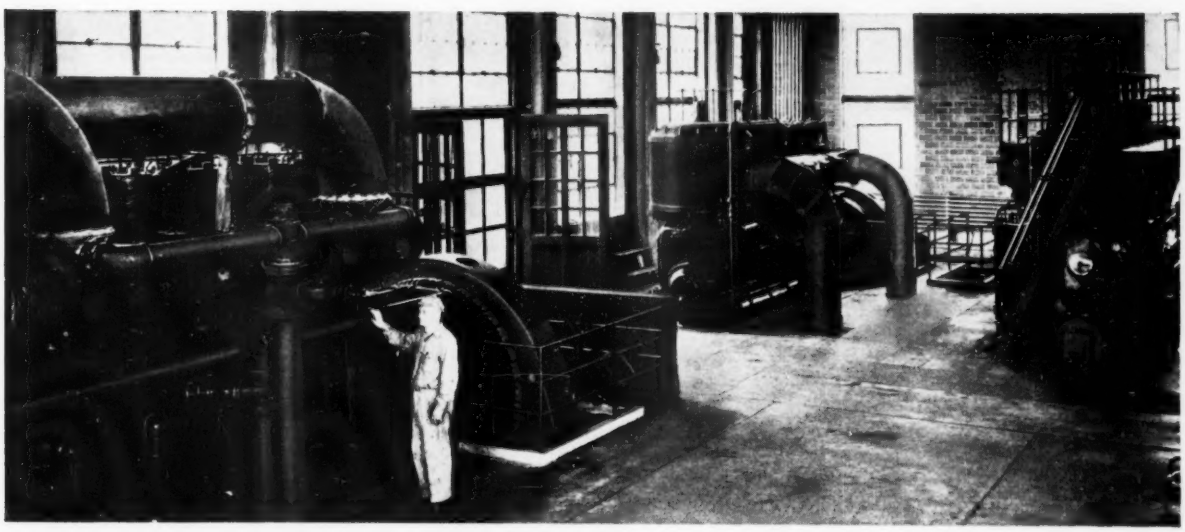
Westinghouse Electric Corp, Pittsburgh 30, Pennsylvania

(*Continued on page* 170)

For more data on these items, use post cards p. 163. Identify your request with item number.

H. L. Ostness, Chief Engineer, River Falls Municipal Utility, Wisconsin, says...

"Sticking Rings are no problem in this Plant"



Mr. Ostness, as chief engineer of one of the oldest Municipal Power Plants in Wisconsin, knows diesels – *knows how to get the most out of them.* Mr. Ostness recently wrote, "We have used Sinclair Lubricants for over fifteen years very successfully. GASCON® and RUBILENE® H.D. have been doing an outstanding job in our diesels. Stuck rings is a trouble we know nothing about – engine wear is at an absolute minimum. With results like these, we'd recommend Sinclair Lubricants any time."

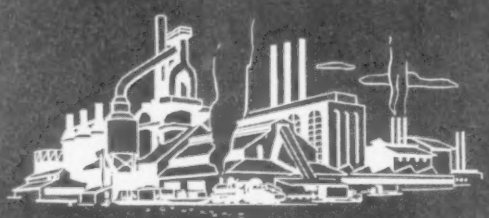
If your present lubricants do less, why not let Sinclair help you get longer life from your diesels – with less trouble. Contact your nearest Sinclair Representative or write Sinclair Refining Company, 600 Fifth Avenue, New York 20, N. Y.

SINCLAIR DIESEL LUBRICANTS

save wear and replacement

ILLCO-WAY ionXchange

serving the essential power plants of American industry



pioneers and leaders in ionXchange

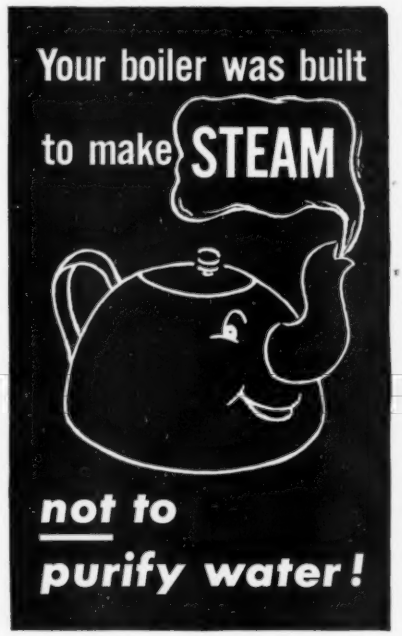
ILLCO-WAY "firsts" include manufacture of the first commercial two-bed De-ionizer . . . the first commercial mixed-bed De-ionizer . . . and the development and building of the first successful installations for the purification of such liquids as beet-juice and crude glycerol by ionXchange . . . In the power field, boiler feed water treatment by ILLCO-WAY ionXchange has long meant lower operating costs and increased operating efficiency. Installations in leading plants.

ILLCO-WAY

DE-IONIZING
DE-ALKALIZING
SOFTENING

For complete data, see Sweet's File, Power Plant

ILLINOIS WATER TREATMENT CO., 853-11 Cedar St., Rockford, Illinois
141 East 44th Street, New York 17, N.Y.
Canadian Distributor: Pumps & Softeners Limited, London, Canada



OUTSIDE the boiler

is the logical place to treat feedwater! An ILLCO-WAY De-ionizer removes objectionable solids the logical modern way . . . by ionXchange . . . economically . . . *before* water enters the boiler.

Remove dissolved solids ILLCO-WAY De-ionizers provide water free of dissolved solids, silica and CO_2. Manual or automatic controls; flow rates to meet plant requirements.

Remove hardness ILLCO-WAY Softeners (manual or fully automatic) provide any required amount of zero-soft water. Compact, economical, easy to operate.

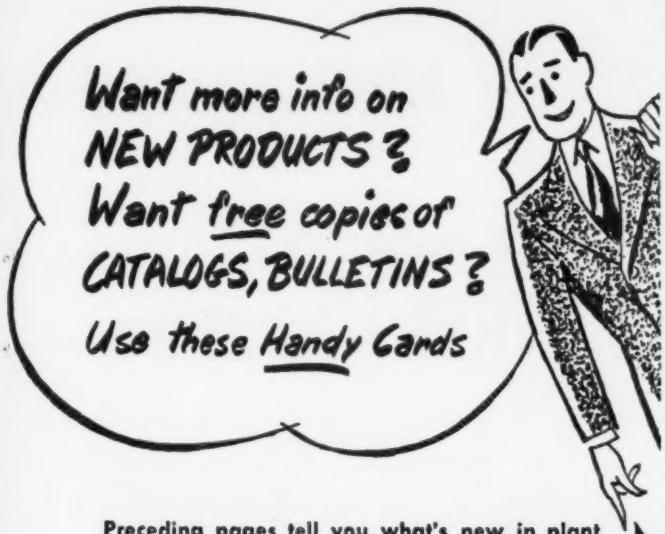
Remove alkalinity ILLCO-WAY Hydrogen Zeolite units reduce alkalinity, soften plant supply. Water with controlled alkalinity and zero hardness to meet requirements.

Send for your free copy...

of Boiler Feed Water bulletin "Treatment X," containing performance data, installation views. Please write on company letterhead. Address: Ill. Water Treatment Co., 853-11 Cedar Street, Rockford, Ill.

Treatment "X"

ILLCO-WAY



Preceding pages tell you what's new in plant equipment. Each item is numbered. For more info on any of them, write in their numbers here

New free catalogs and bulletins are listed beginning on back of this page. To order those you want, write in their item numbers here

Put 2¢ stamp on self-addressed card and mail it to us. We'll pass along your requests to the various companies, they'll send the info

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It appeared on page ____ of the ____ issue of POWER.

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Company .....

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City, State .....

This month's FREE Literature

AIR CONDITIONING

1 **Electric circulation heaters**—featured in 2-color, 8-page bulletin. Fully packaged units have built-in elements, heating chamber, thermostat, insulation and mounting lugs. Bulletin 701, Edwin L Wiegand Co, Thomas Blvd, Pittsburgh 8, Pa.

2 **Vertical-rotor wet-type**—dust and fume eliminators described in 3-color, 4-page leaflet. Capacities range from 500 to 50,000 cfm. Bulletin VU-8-53, Schmieg Industries, Inc, Box 4701, Detroit 34, Mich.

BOILERS & AUXILIARIES

3 **Spreader stoker**—for boilers and steam generators in the 5 to 75,000 lb output range discussed in 3-color, 16-page booklet. Photos, sectional drawings. Bulletin 800, Detroit Stoker Co, Detroit 2, Mich.

4 **Boilers**—for high and low pressures and for oil or gas firing covered in 6-page, 3-color folder. Photos, sectionals, cutaways. Catalog 98, Kewanee-Ross Corp, Kewanee, Ill.

CONTROLS

5 **Disconnecting switch—, *PMB-236*** — for group operation explained in 2-color, 6-page folder. Photos, cutaways, full specs. Pub. 5305. H K Porter Co, Inc, Chicago 12, Ill.

6 **Electronic controllers**—presented in 16-page bulletin. Photos, full specs on instruments for indicating or recording temperature, pressure, flow, liquid level, humidity, time program. Bulletin B226, Bristol Co, Waterbury 20, Conn.

7 **Starters**—for squirrel-cage, synchronous, wound rotor and multi-speed motors in ratings from 2200 to 5000 v described in 2-color, 12-page booklet. Photos, sketches, full specs. Bulletin 14B6410B, Allis-Chalmers Mfg Co, Milwaukee 1, Wis.

8 **Pyrometer supplies**—discussed in 48-page catalog. Photos and full specs on selection and application of thermocouple assemblies and components. Buyer's Guide 100-5, Minneapolis-Honeywell Regulator Co, Wayne & Windrim Ave, Philadelphia 44, Pa.

9 **Circuitbreaker panelboard**—for lighting and appliance branch circuit application featured in 2-color, 8-page catalog. Photos, application data, design details. Booklet B-5644, Westinghouse Electric Corp, Pittsburgh 30, Pa.

10 **Station-type**—cubicle switch-gear presented in 2-color, 24-page booklet. Photos, sketches show details of construction and operation. Booklet B-5670, Westinghouse Electric Corp, Pittsburgh 30, Pa.

11 **Oil-immersed**—motor starters presented in 8-page booklet. Photos, cutaways, dimensional drawings, full specs. GEA-3541, General Electric Co, Schenectady 5, N. Y.

ELECTRICAL EQUIPMENT

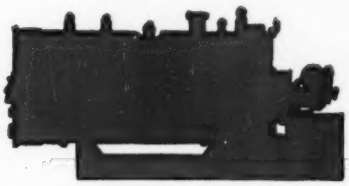
12 **Power oil**—circuit breakers designed for outdoor distribution service described in 2-color, 4-page folder. Photos, dimensional drawings, full specs. Bulletin 71B7946, Allis-Chalmers Mfg Co, Milwaukee 1, Wis.

13 **Dry-type distribution** — transformers explained in 3-color, 4-page folder. Units are Class B insulated 80 C rise type in ratings 3-100 kva, single-phase, 600 v and below. Bulletin EU-106 No. 12, Wagner Electric Corp, 6400 Plymouth Ave, St Louis 14, Mo.

14 **Dry-type transformers**—covered in 2-color, 8-page folder. Photos, full specs, construction sketches, price and selection data. Catalog 353, Hindle Transformer Co, Inc, Woods Church Rd, Flemington, N. J.

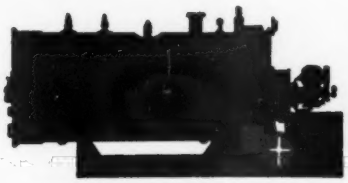
(Continued on page 244)

HOW SUPERIOR SOLVES YOUR STEAM PROBLEMS



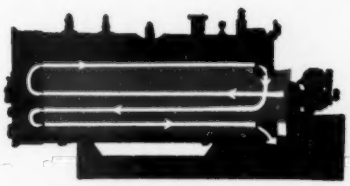
A COMPLETE PACKAGE

Completely factory-assembled and tested, a Superior Steam Generator is backed by undivided responsibility.



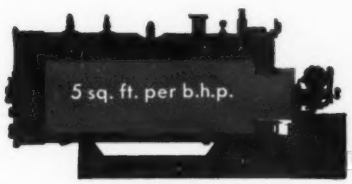
INDUCED DRAFT THAT'S BUILT-IN

... eliminates need of an expensive chimney ... Multiple fans draw evenly on all tubes, reducing maintenance.



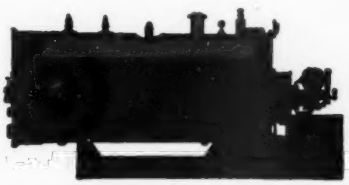
4-PASS, DOWN-DRAFT DESIGN

High gas velocities produce high efficiency. Down-draft design promotes rapid evaporation, quicker steaming.



AMPLE HEATING SURFACE

A minimum of 5 sq. ft. of heating surface per boiler horsepower assures maximum efficiency at full rated capacity.

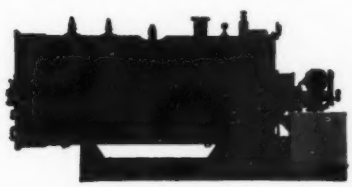


RESERVE CAPACITY

Greater steam space and large evaporating surface provide ample reserve capacity & better than 99% dry steam.

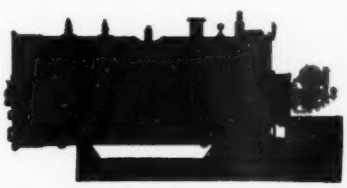
NO EXPENSIVE FOUNDATION

Built on a rigid channel iron base, a Superior Steam Generator needs only a floor capable of supporting its weight.



BUILT-IN CONTROLS

All controls essential to completely automatic operation are factory-wired into an easily accessible control panel.



BURN OIL, GAS, OR BOTH

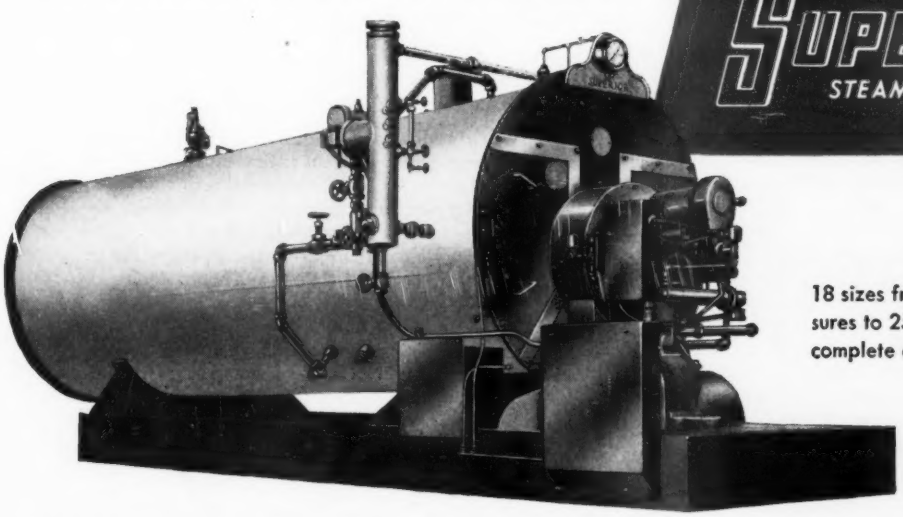
Superior Burners burn oil or gas or a combination of both ... changing from one fuel to the other in seconds.

Superior Steam Generators are the ideal choice for a new steam plant ... the simplest answer to expanding your present plant ... the easiest solution to replacing obsolete boilers.

Guaranteed to develop maximum rated capacities at thermal efficiencies in excess of 80%, their design embodies features which insure long-lived dependability and maximum fuel economy.

for performance you can **BANK** *on*

SUPERIOR
STEAM GENERATORS



18 sizes from 20 to 600 b.h.p. for pressures to 250 p.s.i. or for hot water. For complete details write for Catalog 500.

SUPERIOR COMBUSTION INDUSTRIES INC. TIMES TOWER, TIMES SQUARE, NEW YORK 36, N.Y.

George Edwards' Scrapbook

The only way in which one human being can properly attempt to influence another is to encourage him to **think for himself,** instead of endeavoring to instil ready-made opinions into his head. —Sir Leslie Stephen

* * *

I met a traveller from an antique land
Who said: Two vast and trunkless legs of stone
Stand in the desert. Near them, on the sand,
Half sunk, a shattered visage lies, whose frown,
And wrinkled lip, and sneer of cold command,
Tell that its sculptor well those passions read
Which yet survive, (stamped on these lifeless things,)
The hand that mocked them and the heart that fed:
And on the pedestal these words appear:
"My name is Ozymandias, king of kings:
Look on my works, ye Mighty, and despair!"
Nothing beside remains. Round the decay
Of that colossal wreck, boundless and bare
The lone and level sands stretch far away.
from "Ozymandias"—Percy Bysshe Shelley

* * *

Heard from my friend Frank A Taylor, head curator of Engineering and Industries at Smithsonian Institute in Washington, D C.

He writes, "We are generating interest in a **museum of history and technology.** New museum will present America's history and technology from original settlement to position of world power. Aim will be to show how technology and industry made us a great nation. Other exhibits will cover engineering and scientific developments. With our Dr. Carmichael's belief in need for this museum, I'm certain we will interest people for needed support. . . ."

I seldom visit Washington without taking my friends through his engineering buildings. Last year I had a tough time getting my young son out of there. We all should certainly encourage this new project so engineers following in our footsteps will benefit from this remarkable institution.

* * *

Do not waste your time on Social Questions. What is the matter with the poor is **Poverty.** What is the matter with the idle rich is **Uselessness.** —George Bernard Shaw

Rocket technicians at White Sands, N. M. have this saying. "You either have **just had trouble,** or you are now having trouble, or you are about to have trouble."

This is nothing new to a power engineer. Life is one headache after another whether we design, operate or maintain a power plant. But have you ever thought that if it weren't so, any office girl could take our place. And furthermore, what greater satisfaction do we have than licking a really tough problem?

* * *

"Operating in a power plant is a **tough way** to make an easy living. —Marmaduke Surfaceblow

* * *

P W Bridgman of Harvard University has been experimenting with high pressures up to **350,000 atmospheres.** Says he, "It is paradoxical that one of the greatest difficulties which at first opposed our entry into the high-pressure field, namely, leak of the transmitting liquid, disappears at pressures above 30,000 atmospheres. Simple reason is that there are no more liquids above the pressure—all liquids having been frozen solid by the pressure."

* * *

Human nature craves **novelty.** —Pliny

* * *

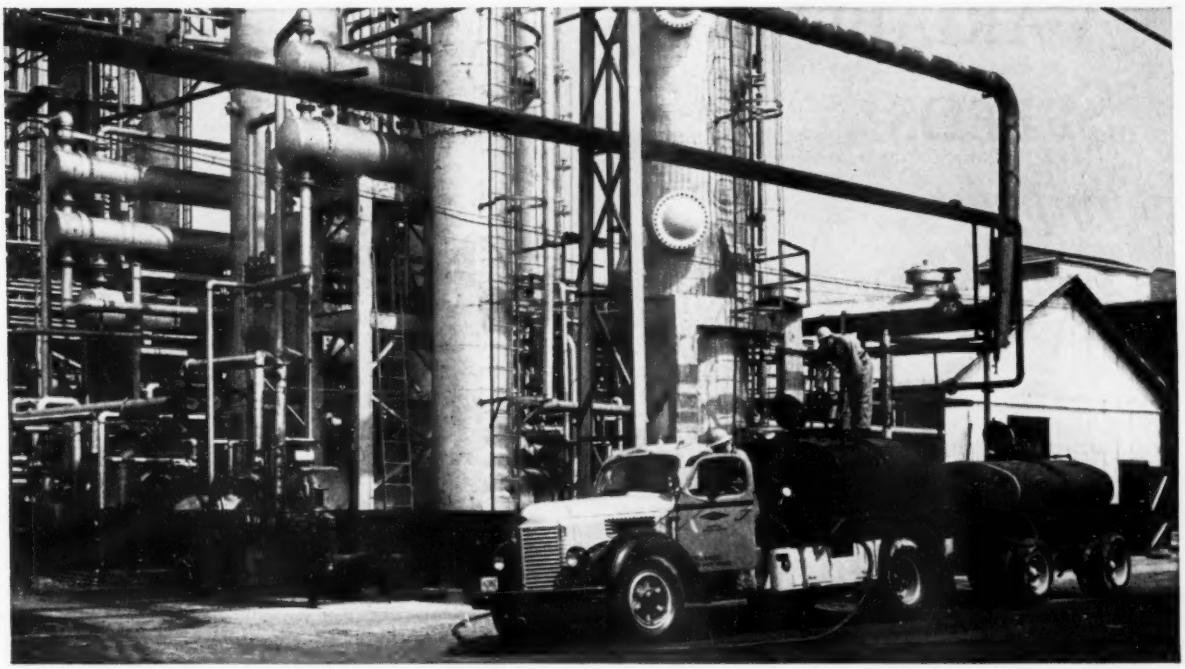
New General Motors **research, engineering and development** center is about half completed. It will employ 3500 scientists, engineers, researchers, stylists, designers, shopmen, mechanics and other specialists. "End objective is more and better things at lower prices, thus expanding job opportunities and contributing to an advanced standard of living," said board chairman A P Sloan, Jr.

I'm sure this sort of thing is our greatest "secret weapon" and the best answer to the many crackpot 'isms' floating around the world.

George Edwards
Engineer

HEAT EXCHANGER EFFICIENCY RESTORED BY DOWELL SERVICE

Scale deposits removed by chemistry without dismantling equipment . . . without production shut-down



When scale and sludge accumulate on your heat transfer equipment, there's bound to be a reduction in efficiency with an increase in operating costs.

The Dowell method of removing scale and sludge *by chemistry* has been accepted by thousands of plant operators as a fast, safe and economical way to help restore efficiency to equipment.

Dowell was recently called upon to clean three badly fouled heat exchangers in a refinery. Dowell engineers pumped liquid solvents into the areas of the exchangers to be cleaned. Then, after sufficient reaction time, the spent solutions were flushed from the units, along with the sludge accumulations. After cleaning, one unit could carry the load previously carried by all three.

The Dowell method is fast and economical because solvents are pumped into equipment through regular connections without dismantling. Many types of equipment can be cleaned while in operation. No special devices or rig-ups are needed. It's efficient, too, because these solvents reach wherever steam and water flow. Even the most complicated heat transfer surfaces—angles, curves, piping—have been cleaned effectively in this manner.

Furthermore, Dowell furnishes the trained personnel, the truck-mounted tanks, pumps, heaters, mixers and control equipment to do the job.

What's *your* cleaning problem? Dowell engineers will be glad to talk with you about better, faster and more economical ways to clean your equipment. Contact your nearest Dowell office today. Or, write directly to Tulsa, Dept. K-23.

DOWELL SERVICE

Over 100 Offices to Serve You with Chemical Cleaning for:

Boilers • Condensers • Heat Exchangers • Cooling Systems
Pipe Lines • Piping Systems • Gas Washers • Process Towers
Process Equipment • Evaporators • Filter Beds • Tanks

Chemical Services for Oil, Gas and Water Wells

DOWELL INCORPORATED · TULSA 1, OKLAHOMA

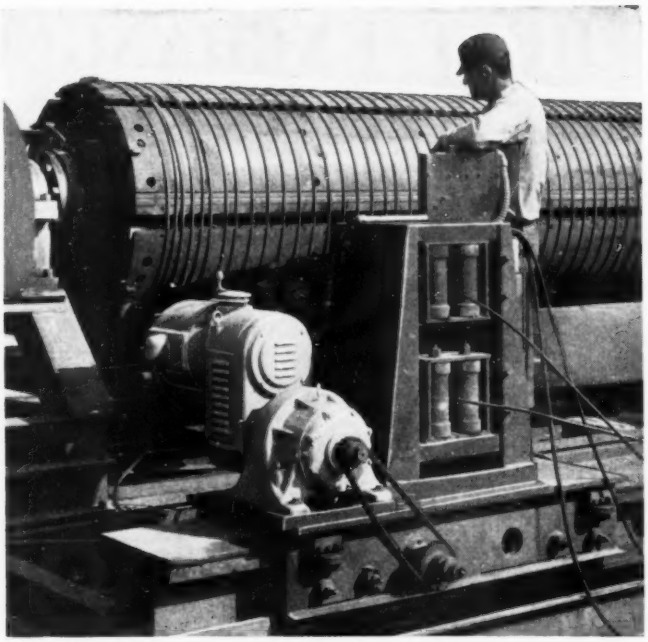
DOWELL

A Service Subsidiary of
THE DOW CHEMICAL COMPANY

(Advertisement)

THIS MONTH'S MOTOR TIPS

How Variable Speeds *improve production tempo*



U. S. Varidrive motor operating special drum machine for fabricating circular reinforcing cages for concrete pipe; permits speed variation to suit each diameter of wrapping.

COUNTLESS PLANTS ARE SWITCHING TO VARIDRIVE MOTORS FOR OUTPUT EFFICIENCY

Making machines more responsive to the operator's command has resulted in an amazing step-up in production. Machines powered with conventional constant-speed motors "loaf on the job" during many operations, but the same machines driven with Varidrive motors can accomplish one or a combination of these improvements—(1) increase production by the adjustable "overdrive" of accelerated speed; (2) effect better cutting or operating action by setting speed at the precise rpm essential for the job; (3) provide the operator with infinite speeds to coordinate with his rhythm of movement or selection of speed that is, in his judgment, just the exact rpm to produce his best workmanship.

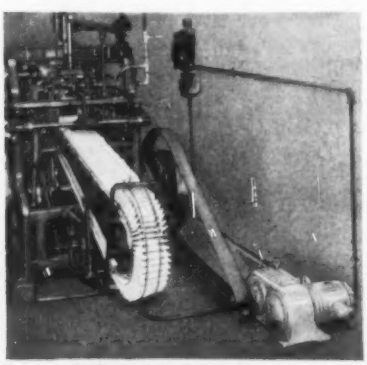
Just as an automotive engine operates at highest efficiency at a certain speed, almost any production machine or powered equipment will produce more where selectivity of motor speeds is provided. In a study of advantages created by the use of variable speeds, the manufacturers of U. S. Varidrive motors have compiled a list of applications covering diversified fields ranging from sewing machine factories to sorghum mills. From most of these interesting applications the design engineer and plant production engineer can learn of uses they can apply to their own sphere of operations.

NO GUESSING OF MOTOR SPEED

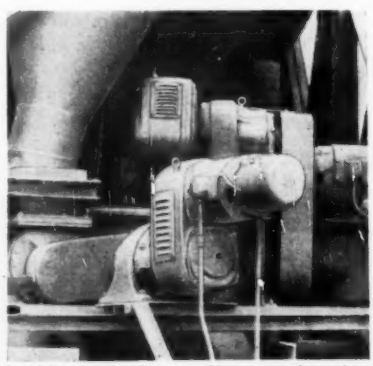
For instance, the design engineer doesn't have to try to guess what the ultimate speed factor will be in order to be sure his machine will deliver the full optimum of production *after* installation. By installing a Varidrive motor he endows his product with speeds instead of a speed; consequently in service his machine presents an "ableness" to adapt itself to a wide range of conditions far beyond his contemplation. If a fixed speed motor operates the machine the design engineer might have guessed wrongly the speed to give it.

REMOVING RESTRICTIONS OF SPEED

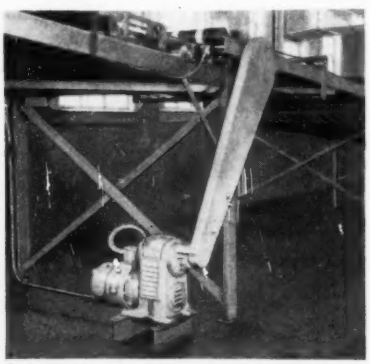
The plant production engineer need not be restricted to a set operating speed of a machine. He can, with the Varidrive, experiment with speeds to do a specific job best. For example, a conveyor may at times, when heavily loaded, require slow speed, then higher speed when the load is light, or when parts have to get to a worker's location



Envelope folding and glueing machine powered with U. S. Varidrive. For different sizes of envelope a different speed is required.

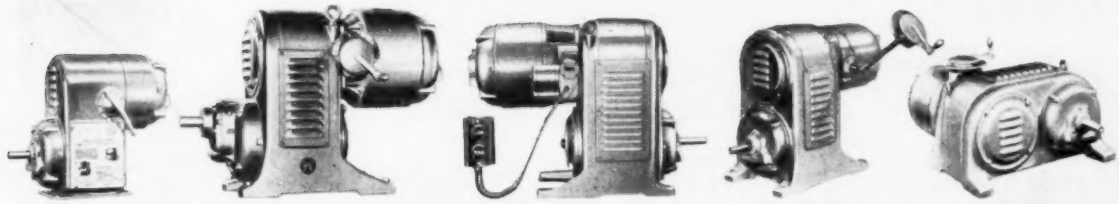


Varidrives on a mixing machine processing rotary drilling oil base. The proper mix depends on the exact speed required to blend materials.



Conveyor travel is controlled for better distribution and timing with a Varidrive. This conveyor is an automatic system for drying printed material.

TYPICAL VARIDRIVE MOTOR TYPES



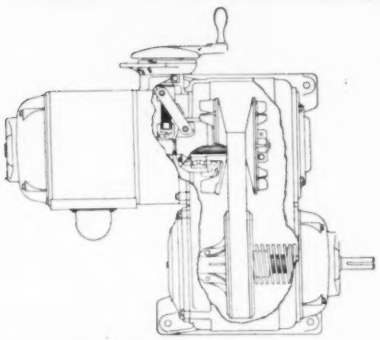
TYPE VA—SMALL H.P.
Low cost model, ¼ to ¾ h.p. 4 to 10,000 rpm. Ratios 10:1. 1 & 3-phase.

TYPE VEU—GH
Upright case with low shaft. Control dial on side.

ELECTRIC CONTROL
Varidrive with Type ERC heavy-duty remote control motor.

REMOTE CONTROL
One of many control arrangements. Control shaft can be extended.

TYPE VE
Horizontal case with control dial on top of motor.



OPERATION OF A VARIDRIVE

By turning control dial, the diameters of the belt discs expand or contract, thus changing fixed speed of motor shaft to variable speed of the take-off shaft. Quiet, shockless, enclosed transmission.

faster. In cutting shafts on a lathe from large to small diameter, frequent change in speed keeps the power tool operating at a uniform lineal travel to get the job completed in the least time. With a Varidrive, the speed can be instantly changed to synchronize with each specific travel or load condition.

Machines turning out different sizes of parts can produce better with variable speeds. If work chatters, feed can be adjusted for best surface speed, longer tool life and finer workmanship.

In experimental processes involving mixing in vats under varying conditions of viscosity, temperature, homogenization or rate of agitation, variable speed plays an important role, which is impossible with a fixed speed motor. The right speed makes all the difference in getting the right mix. With Varidrive no step-cone pulleys, external gears, intermediate speed changers or connections, such as extra chains and couplings are needed. Usually a Varidrive can be direct connected to the prime driving shaft of the machine or equipment.

In pumping and hydraulic control operations variable speed is the answer. Flow, pressure, suction and load can be maintained at just the right equilibrium by a Varidrive. In some machines the exasperating problems of noise, chatter, vibration, over-heating and pulsation contribute to the shortened life of equipment, or affect the quality of the product undergoing processing. These troubles can be invariably "cured" with a Varidrive because the operator can experiment down to a split rpm to get the most sensitive speed to overcome the trouble.

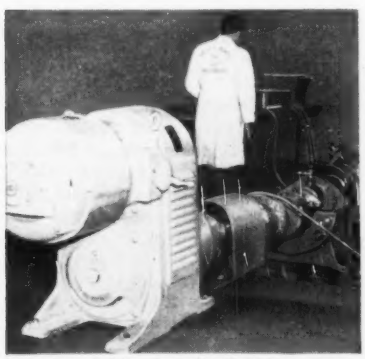
SPEEDS TO FIT TIMING FACTORS

Equipment is frequently required to complete an operation in predetermined time. Variable speed permits a step-up or step-down to establish the right production tempo. In controlling cycles of infra-red baking, drying, heating, soaking, grinding, capping, tumbling, coating, plating, etc., speed movement must be precise—or rejects will cut into profits. What, then, is more logical than to install a Varidrive to provide the nerve-center of speed regulations?

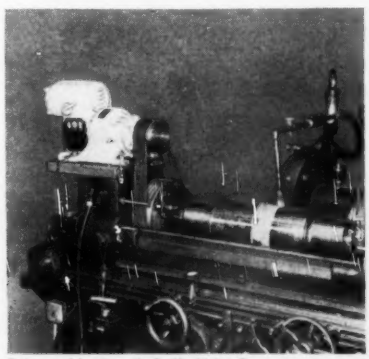
IMPROVEMENT IN OUTPUT

In thousands of plants, the U. S. Varidrive motor has brought about amazing improvements in production. Powered machines have had their output stepped up to 30 percent or more in innumerable instances.

In general, these Varidrives can be obtained in a range of from ¼ to 50 h.p., and for speeds from 2 to 10,000 rpm in ratios of 10:1.



In a research laboratory this Varidrive motor operates test equipment for checking performance characteristics of water pumps.

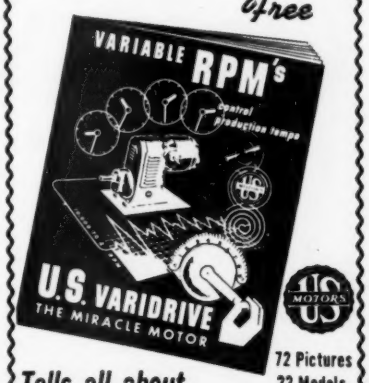


This combination U. S. Varidrive-Syncrogear powers a special roll grinding machine for cold rolling aluminum sheets, from heavy to light gauge.

ADVERTISEMENT

16-Page Motor Booklet

Free



72 Pictures
22 Models

Tells all about

U. S. VARIDRIVE MOTORS

Mail the Coupon

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U. S. ELECTRICAL MOTORS Inc. P-11
Box 2058, Los Angeles 54, Calif., or Milford, Conn.
Send free 16-page Booklet. No obligation

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Give yourself the

Unbeatable Performance of the RIDGID Heavy-Duty Pipe Wrench

If this Housing ever Breaks or Distorts we will replace it Free
14
HEAVY DUTY
RIDGID
"RIDGID" means most service for your money!

Every RIDGID Wrench Factory-Tested

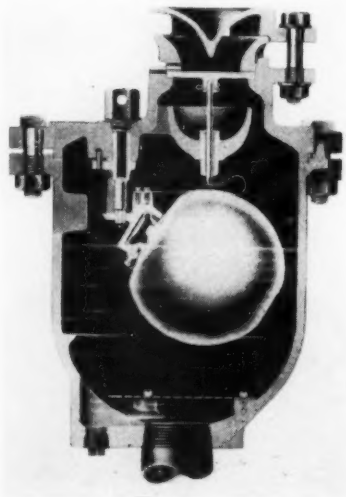
That's what makes sure that every RIDGID performs as you've learned to expect... *every* part inspected, *every* wrench pipe tested 100%! Only RIDGID's housing is unconditionally guaranteed, saving you bother and expense. Full-floating hookjaw, adjusting nut spins easily in all sizes, 6" to 60"; replaceable alloy jaws, handy pipe scale on hookjaw, comfort-grip I-beam handle. For most service for your money, buy RIDGID's . . . at your Supply House.

THE RIDGE TOOL COMPANY • ELYRIA, OHIO, U.S.A.

RIDGID
Work-Saver Pipe Tools

More EQUIPMENT NEWS

Begins on page 154



Air Release Valve

1108 • Type AV air release and vacuum breaking valve automatically releases air accumulations from pipe systems, admits air to systems to break vacuums, and vents large quantities of air from pipe lines when filling systems with water. Device combines three functions in one body. Valve has 11½-in. maximum dia and overall height of 16¼ in. Weight of each unit is 160 lb.
Simplex Valve & Meter Co, 68th & Upland St, Philadelphia 42, Pa.

For more data on these items, use post cards p. 163. Identify your request with item number.

Self-clearing Valves

1160 • Low-leakage self-clearing servo valve features 2-stage 4-way operation with internal mechanical feedback for transformation of low-level electrical information into controlled hydraulic energy. Unit is sealed against magnetic particles, can be operated without oil filters. Clearing force is up to 500 lb. Frequency response is flat from 0 to 150 cps.

Valve is 1 5/16x2 7/16x5½ in. with volume of less than 18 cu in. and flow of up to 12 gpm. Life of unit is at least 4-million cycles, manufacturer claims. Weight is less than 1¾ lb.
Sanders Associates, Inc, Nashua, N. H.

Valves

1161 • New valves are claimed to replace either gate valves or diaphragm valves. Movement of small pilot cock or remote control operation moves valve to open or closed positions. *Flowtrol* valves can be used on water, oil, air and many other fluids at pressures ranging from 15 to 400 psi. They are available in sizes from 2 through 36 in.

Design and construction features, complete parts list, dimensions and specifications are covered in bulletin W-8.
Golden-Anderson Valve Specialty Co, 2070 Keenan Bldg, Pittsburgh 22, Pa.

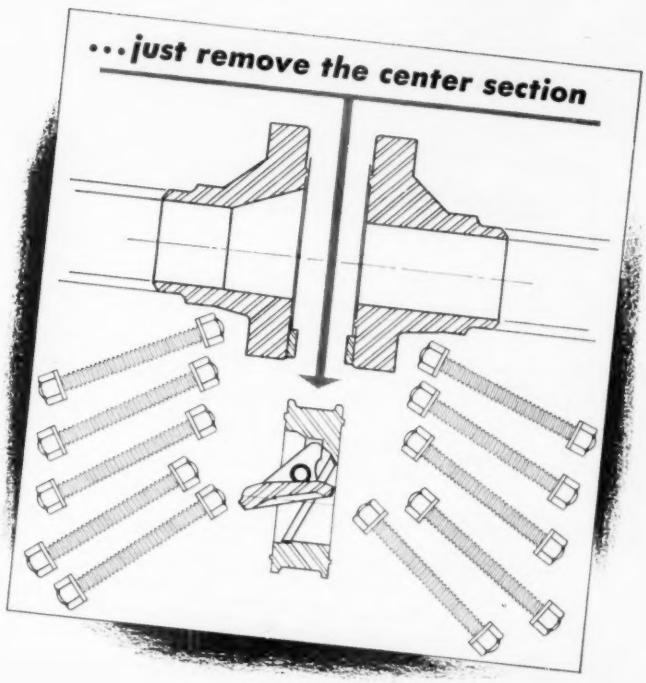
(*Continued on page* 174)

NO NEED to cut this valve out of a Welded Line

...it's a CHAPMAN 3-PIECE TILTING DISC CHECK VALVE

Remove studs between inlet and outlet ends. Then the whole center section can be slipped out *as a unit* . . . and quickly and easily replaced. Figure the savings for yourself!

Here, Chapman design gives you the smooth operation and quiet closing of the 2-piece Tilting Disc Check Valve . . . with the unique advantage of practically immediate interchangeability of "the works." And *only* Chapman makes this complete line of Tilting Disc Check Valves. Send for your Chapman "Check Book" — *now!*

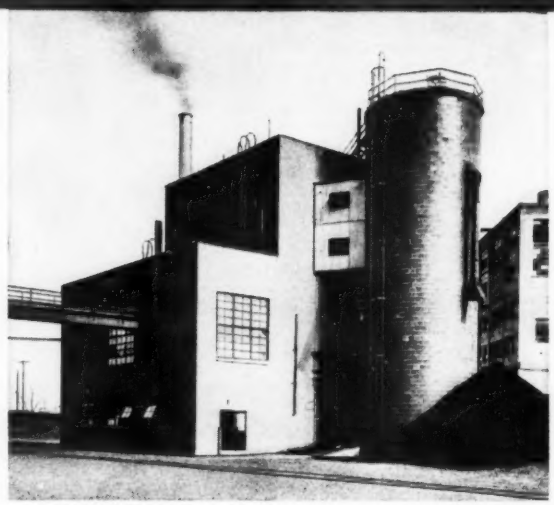


The Chapman Valve Mfg. Co.
INDIAN ORCHARD, MASSACHUSETTS

Quaker Oats BURNING COAL

"Our new coal installation produces steam at a cost of 32¢ per 1000 lbs.... reduces some operating costs about one half,"

says Walter H. Proescholdt
Asst. Chief Engineer
The Quaker Oats Company



To gain economy plus dependability, Quaker Oats Company modernized the boiler room in its paper-making plant. One efficient, coal-fired unit now supplies all steam needed for heating, processing, and power generation.

Boiler and turbine room operations combined. With automatic controls and coal- and ash-handling systems, two men per shift can operate the combination boiler and turbine generator room shown above, right. Quaker Oats has found that burning coal the modern way certainly increases efficiency of operation and cuts operating costs.

Additional case histories, showing how plants of other types have saved money by burning coal the modern way, are available upon request.

If you operate a steam plant, you can't afford to ignore these facts!

BITUMINOUS COAL in most places is today's lowest-cost fuel, and coal reserves in America are adequate for hundreds of years to come.

COAL production in the U.S.A. is highly mechanized and by far the most efficient in the world.

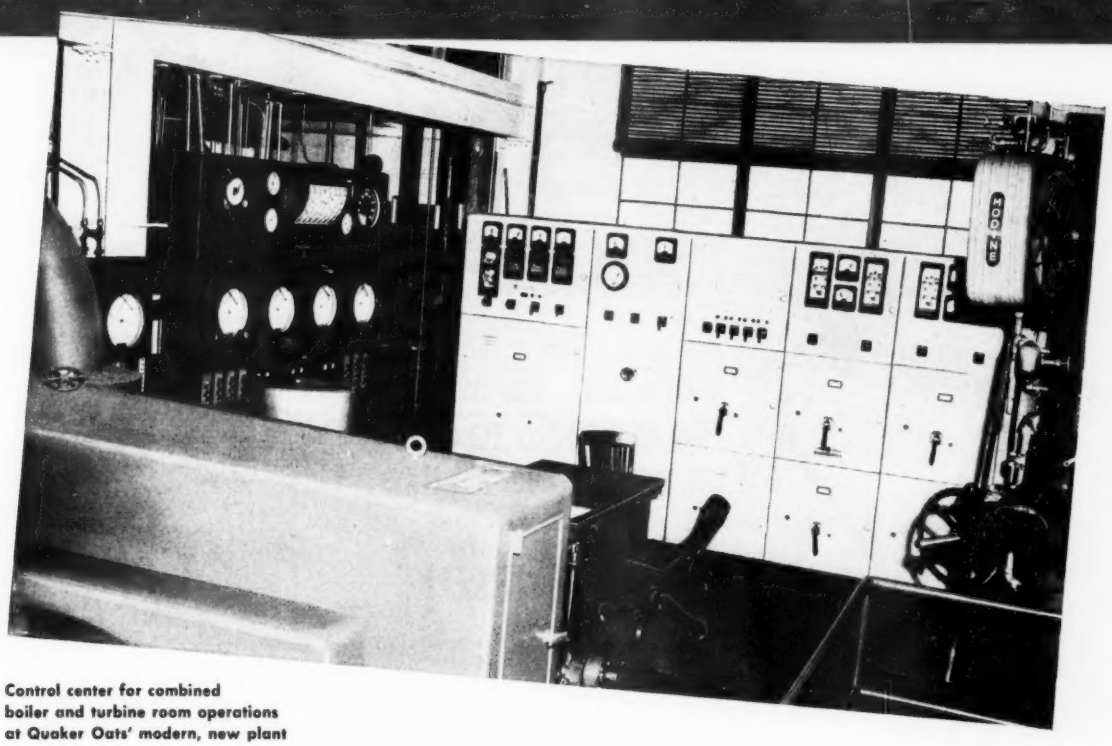
COAL prices will therefore remain the most stable of all fuels.

COAL is the safest fuel to store and use.

COAL is the fuel that industry counts on more and more—for with modern combustion and handling equipment, the inherent advantages of well-prepared coal net even bigger savings.

FOR HIGH EFFICIENCY
FOR LOW COST

REDUCES STEAM COSTS BY THE MODERN WAY



Control center for combined boiler and turbine room operations at Quaker Oats' modern, new plant

Many power plants over ten years old are as dated in efficiency as the automobiles of the same period. Ton for ton, coal burned in a modern plant can produce 10% to 40% more power. Modern coal- and ash-handling equipment can also cut labor costs substantially.

Why not let a consulting engineer look over your plant? Chances are he can point out ways of remodeling so that you can burn bituminous coal the modern way . . . and save dollars.

It pays to burn coal efficiently, because coal is not only an economical, but a dependable fuel. Coal reserves are virtually unlimited. America's coal industry is the world's most efficient and progressive. Thus you're assured of a plentiful supply of coal at relatively stable prices for generations.

BITUMINOUS COAL INSTITUTE
A Department of National Coal Association
Southern Building, Washington 5, D. C.

YOU CAN COUNT ON COAL!

NATIONAL AIROIL

"S-A"

TYPE STEAM ATOMIZING OIL BURNER

VIRTUALLY IMPOSSIBLE FOR ANYTHING TO CLOG OR GO WRONG . . .

. . . SEE FOR YOURSELF!

The popular NATIONAL AIROIL Steam Atomizing Oil Burner *thoroughly atomizes* and *completely burns* the lowest and cheapest grades of fuel oil or tar . . . requires only minimum supervision and maintenance. Only slight oil pressure and temperature is needed . . . and internal atomizing venturi feature assures low steam consumption. NATIONAL AIROIL Type "SA" Oil Burner is adaptable to all types of industrial heating, power or process furnaces . . . is suitable for firing above stoker grates on conversion to oil.

Other "SA" modifications designed for: the burning of Colloidal fuel ("SAR")—Large capacity operation ("SAL")—Sludge burning ("SAD")—Combined steam and mechanical atomization (Dual Stage).

WRITE FOR BULLETIN 21

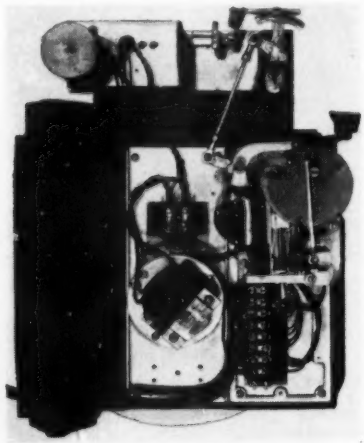
OIL BURNERS and GAS BURNERS for industrial power, process and heating purposes
STEAM ATOMIZING OIL BURNERS
SLUDGE BURNERS, Steam Atomizing
MOTOR-DRIVEN ROTARY OIL BURNERS
MECHANICAL PRESSURE ATOMIZING OIL BURNERS
DUAL STAGE, Combining Steam and Mechanical Atomization
LOW AIR PRESSURE OIL BURNERS
NAIROIL AUTOMATIC OIL BURNERS, or small process furnaces and heating plants
GAS BURNERS
COMBINATION GAS & OIL BURNERS
FUEL OIL PUMPING and HEATING UNITS
FURNACE RELIEF DOORS
AIR INTAKE DOORS
OBSERVATION PORTS
SPECIAL REFRACTORY SHAPES

NATIONAL AIROIL BURNER CO., INC.

1250 EAST SEDGLEY AVE., PHILADELPHIA 34, PA.
Southwestern Division: 2512 South Boulevard, Houston 6, Texas
INDUSTRIAL OIL BURNERS, GAS BURNERS, FURNACE EQUIPMENT

More EQUIPMENT NEWS

Begins on page 154



Electronic Flow Meter

1130 • Electronic type flow meter makes use of mercury-less bellows type transmitters and is available in several different models for indicating, recording and, with a continuous-type mechanical integrator or combinations thereof, for measuring steam, water and other fluid and gas flow. Records of air flow for boiler operation and pressures and temperatures can be combined in same meter. Device can handle differentials of from 20 to 750-in. water with standard static operating pressure of 1500 psig.
Hays Corp, Michigan City, Indiana

For more data on these items, use post cards p. 163. Identify your request with item number.

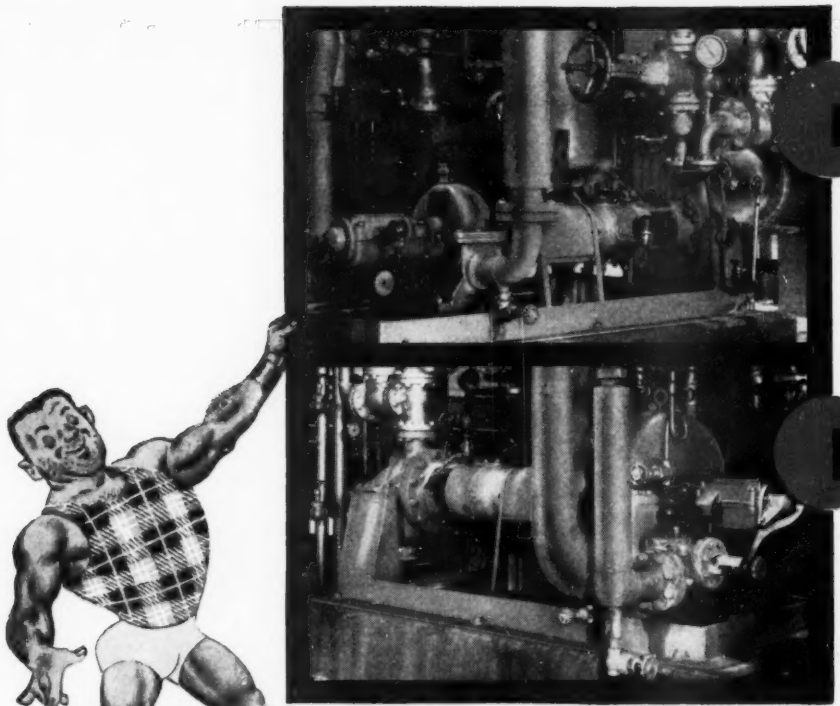
Convex Scale

1138 • New convex scale remote reading gage permits full 180-degree visibility for easy readings from anywhere in control room. Scale markings are directly on convex face; indicator moves completely around the convex surface. Models are available for any pressure or range. Light and horn alarm signals, as well as repeaters for readings at auxiliary points, are available.
Jerguson Gage & Valve Co, 80 Fellsway, Somerville 45, Massachusetts

Sliding Selector Chart

1126 • Automatic sliding selector chart aids in calculating number and type of platecoils required in tank installations. By knowing size of tank in gal or cu ft and heating requirements, user can easily determine Btu's and area of platecoil necessary. Device has C/D slide rule scales.
Tranter Mfg, Inc, Lansing 4, Michigan

(*Continued on page* 178)



POWER!

For Your Small Jobs

Installed in a large southern refinery, this Dean Hill Type DH Steam Turbine efficiently provides all the H.P. needed for driving centrifugal process equipment.

MORE POWER!

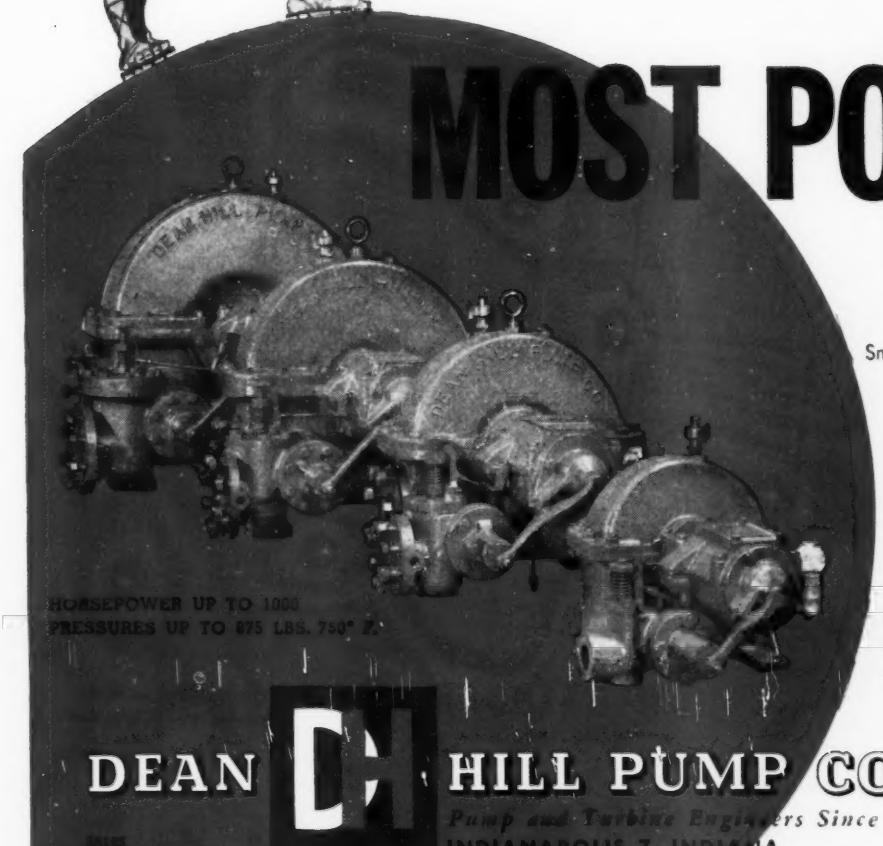
For Your Big Jobs

1,000 H.P. is available for this process pumping operation (same plant as above). Dean Hill is on the job with this powerful steam turbine.

MOST POWER!

For Your Money With DEAN HILL Turbines

Small and large, Dean Hill Turbines are built to give all the power you need, at less expense. Specifically designed for operation at medium steam pressure. Since they are the single stage, double impact type, low steam consumption is a tremendous economy feature. Most key DH Turbine parts are interchangeable in all sizes of DH Turbines. Write today for full details and specifications.



DEAN DH HILL PUMP COMPANY

Pump and Turbine Engineers Since 1895

INDIANAPOLIS 7, INDIANA

Chicago • New York • San Francisco • Boston • Cincinnati • Denver • Albuquerque • El Paso • Salt Lake City • New Orleans • Philadelphia • Tulsa • Los Angeles • Pittsburgh • Houston • Dallas • St. Paul • Toledo • Cleveland • Grand Rapids • Birmingham, Ala. • Louisville • Memphis • Nashville • Richmond • Bogota, Col. • Mexico City • Montreal • Reading, Pa. • The Hague

HERE'S AN EXAMPLE of how Armstrong data help you select the right size trap for the job:

Armstrong trap capacity figures are based on literally hundreds of tests under actual operating conditions with condensate at steam temperature. The choking effect of flash steam through the orifice as well as the back pressure created by flash steam were automatically taken into account. Actual hookups were used to allow for the effect of pipe friction.

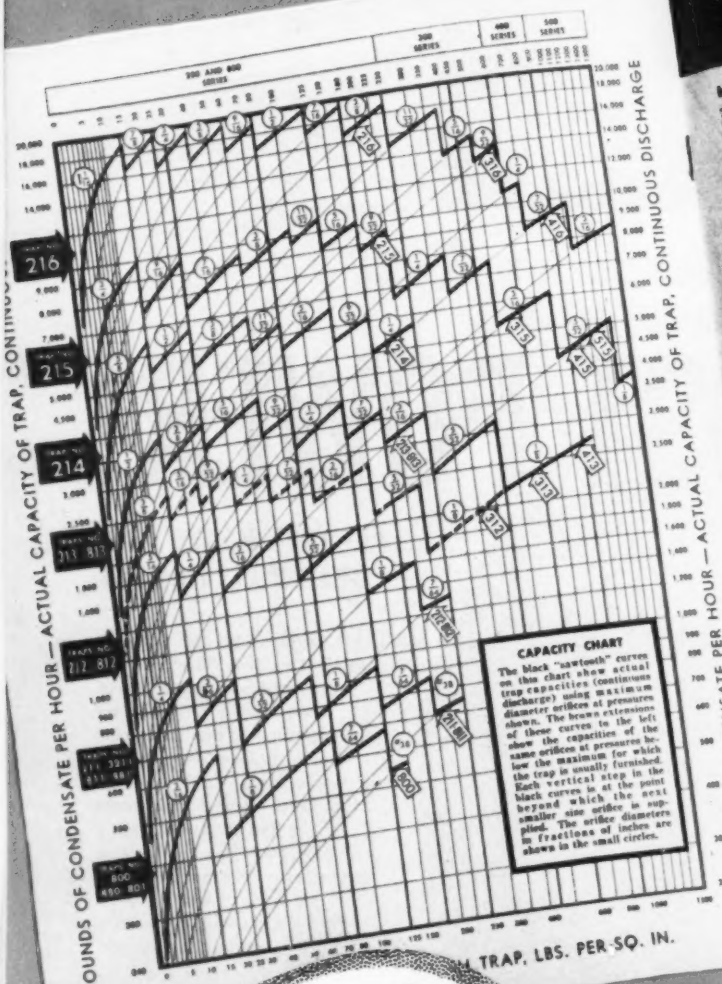
If the capacity ratings had been based on cold water tests, which produce no flash steam they would be too high.

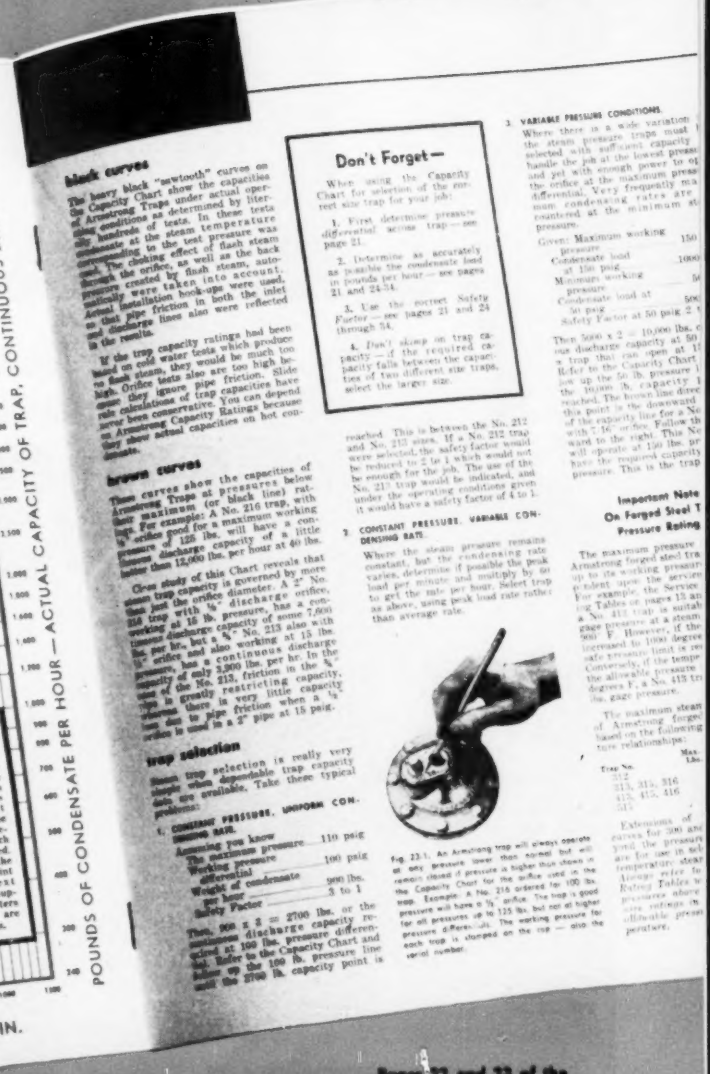
Orifice test ratings are too high because they ignore the effect of pipe friction.

Slide rule calculations of trap capacities have never been conservative.

WHEN YOU SPECIFY A STEAM TRAP you are specifying condensate handling capacity. When you use Armstrong Selection Data and specify Armstrong traps YOU KNOW that you are getting the right trap for the job.

Armstrong traps last longer, too—with less maintenance. And, they are *unconditionally guaranteed* to give complete satisfaction.


POUNDS OF CONDENSATE PER HOUR—ACTUAL CAPACITY OF TRAP, CONTINUOUS DISCHARGE
CAPACITY CHART
The black "sawtooth" curves on this chart show actual trap capacities (continuous discharge) using maximum diameter orifices at pressures shown. The brown extensions of these curves to the left show the capacities of the same orifices at pressures below the maximum for which the trap is usually furnished. Each vertical step in the black curves is at the point beyond which the next smaller size orifice is supplied. The orifice diameters in fractions of inches are shown in the small circles.
TRAP, LBS. PER SQ. IN.



Don't Forget—

When using the Capacity Chart for selection of the correct size trap for your job:

1. First determine pressure differential across trap — see page 21.
2. Determine as accurately as possible the condensate load in pounds per hour — see pages 21 and 24-34.
3. Use the correct Safety Factor — see pages 21 and 24 through 34.
4. Don't skimp on trap capacity — if the required capacity falls between the capacities of two different size traps, select the larger size.

black curves

The heavy black "sawtooth" curves on the Capacity Chart show the capacities of Armstrong Traps under actual operating conditions as determined by literally hundreds of tests. In these tests condensate at the steam temperature corresponding to the test pressure was discharged through the orifice, as well as the back pressure created by flash steam were taken into account. Actual installation hook-ups were used, so that pipe friction in both the inlet and discharge lines also were reflected in the results.

If the trap capacity ratings had been based on cold water tests which produce no flash steam, they would be much too high. Orifice tests also are too high because they ignore pipe friction. Slide rule calculations of trap capacities have never been conservative. You can depend on Armstrong Capacity Ratings because they show actual capacities on hot condensate.

brown curves

These curves show the capacities of Armstrong Traps at pressures below their maximum (or black line) ratings. For example: A No. 216 trap, with ¼" orifice good for a maximum working pressure of 125 lbs., will have a continuous discharge capacity of a little better than 12,000 lbs. per hour at 40 lbs.

Close study of this Chart reveals that steam trap capacity is governed by more than just the orifice diameter. A 2" No. 858 trap with ¼" discharge orifice, working at 15 lbs. pressure, has a continuous discharge capacity of some 7,600 lbs. per hr., but a ¾" No. 213 also with ¼" orifice and also working at 15 lbs. pressure, has a continuous discharge capacity of only 2,300 lbs. per hr. In the case of the No. 213, friction in the ¾" pipe is greatly restricting capacity. Whereas there is very little capacity reduction due to pipe friction when a ¼" orifice is used in a 2" pipe at 15 psig.

trap selection

Steam trap selection is really very simple when dependable trap capacity data are available. Take these typical problems:

1. CONSTANT PRESSURE, UNIFORM CONDENSING RATE.

Assuming you know

The maximum pressure	110 psig
Working pressure	100 psig
differential	
Weight of condensate per hour	900 lbs.
Safety Factor	3 to 1

Then, 900 x 3 = 2700 lbs. or the continuous discharge capacity required at 100 lbs. pressure differential. Refer to the Capacity Chart and follow up the 100 lb. pressure line until the 2700 lb. capacity point is reached. This is between the No. 212 and No. 213 sizes. If a No. 212 trap were selected, the safety factor would be reduced to 2 to 1 which would not be enough for the job. The use of the No. 213 trap would be indicated, and under the operating conditions given it would have a safety factor of 4 to 1.

2. CONSTANT PRESSURE, VARIABLE CONDENSING RATE.

Where the steam pressure remains constant, but the condensing rate varies, determine if possible the peak load per minute and multiply by 60 to get the min. per hour. Select trap as above, using peak load rate rather than average rate.

Fig. 22-1. An Armstrong trap will always operate on any pressure lower than normal but will remain closed if pressure is higher than shown in the Capacity Chart for the orifice used in the trap. Example: A No. 216 ordered for 100 lbs. pressure will have a ⅛" orifice. The trap is good for all pressures up to 125 lbs. but not at higher pressure differentials. The working pressure for each trap is stamped on the top — also the serial number.

3. VARIABLE PRESSURE CONDITIONS

Where there is a wide variation in the steam pressure traps must be selected with sufficient capacity to handle the job at the lowest pressure and yet with enough power to open the orifice at the maximum pressure differential. Very frequently maximum condensing rates are encountered at the minimum steam pressure.

Given: Maximum working pressure 150
Condensate load at 150 psig 1000
Minimum working pressure 50
Condensate load at 50 psig 500
Safety Factor at 50 psig 2 to 1

Then 1000 x 2 = 10,000 lbs. capacity discharge capacity at 50 psig. Refer to the Capacity Chart and follow up the 50 lb. pressure line to the 10,000 lb. capacity line reached. The brown line directly above this point is the downward extension of the capacity line for a No. 216 trap with ¼" orifice. Follow this line downward and to the right. This No. 216 will operate at 150 lbs. pressure and have the required capacity at that pressure. This is the trap

Important Note On Forged Steel Trap Pressure Rating

The maximum pressure ratings of Armstrong forged steel traps are given as working pressures. The gage pressure at which a trap is actually used is dependent upon the service conditions. For example, the service rating Tables on pages 13 and 14 show that a No. 212 trap is suitable for a maximum steam gage pressure at a steam temperature of 900° F. However, if the temperature is increased to 1000 degrees F., the maximum pressure limit is reduced to 150 lbs. gage pressure. Conversely, if the temperature is reduced to the allowable pressure will be increased to 1000 degrees F., a No. 413 trap is suitable for 300 lbs. gage pressure.

The maximum steam pressure ratings of Armstrong forged steel traps are based on the following temperature relationships:

Trap No.	Max. Lbs.
212	
213, 313, 516	
214, 415, 416	
215	

Extensions of the brown curves beyond the pressure lines of the Capacity Chart are for use in selecting the proper steam temperature ratings. Always refer to the Steam Rating Tables to determine the proper temperature ratings for the allowable pressures.

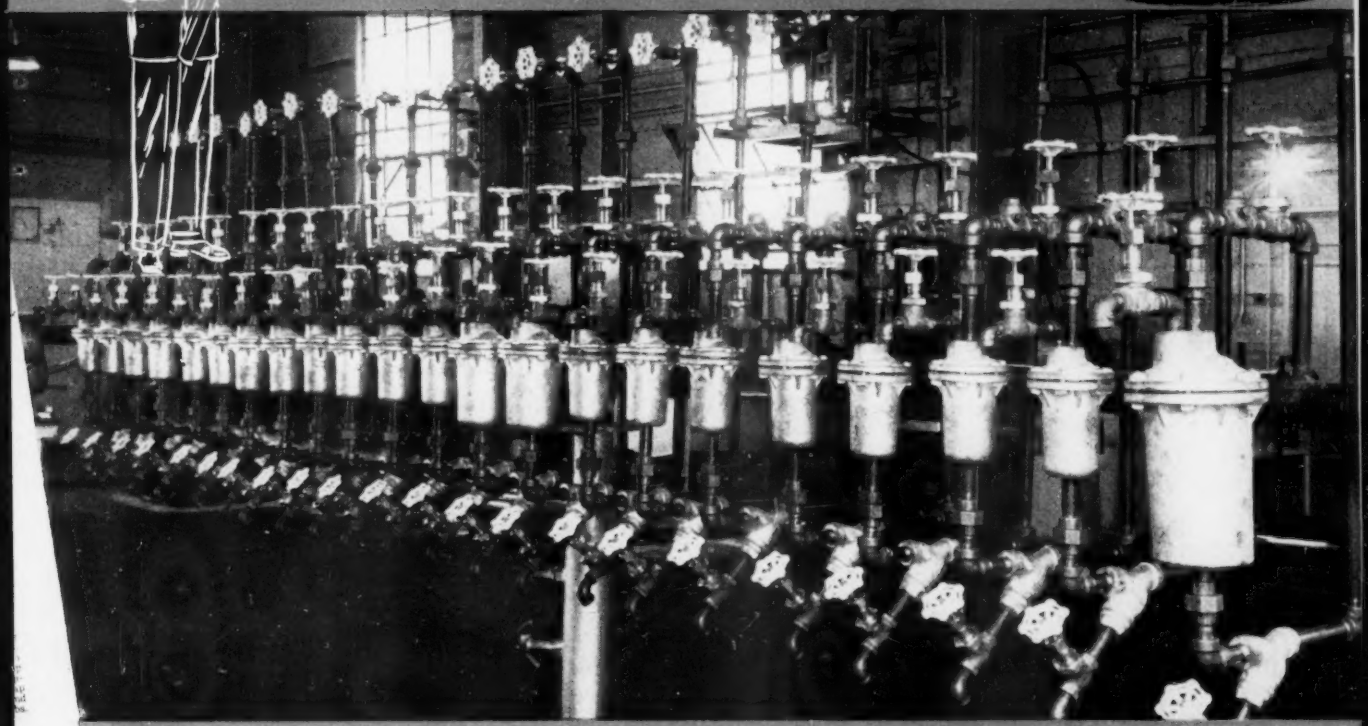
Pages 22 and 23 of the Armstrong Steam Trap Book.

You're getting a known quantity when you specify

ARMSTRONG

No trial and error on that job . . . .

ARMSTRONG TRAP DATA are Reliable



THE most carefully calculated installation of steam-heated processing equipment will fail to deliver full output if the steam traps do not have adequate condensate and air handling capacity. When this happens an important part of the capital investment in plant and equipment is wasted.

After you have figured the amount of steam that will be condensed, you need data on:

Condensate Capacity—not theoretical, not estimated, not cold water, but actual test findings with traps discharging condensate at steam temperature (see the discussion on the left-hand page).

Trap Capacity Safety Factors, or ratio between continuous discharge capacity and actual amount of condensate to be handled. These may run from a low of 2 to 1 or as high as 8 to 1. Armstrong data tells you just what safety factor to use to obtain adequate air venting capacity and maximum heat transfer.

Armstrong trap data helps you get traps "big enough" for the job, but not too big; assures you maximum operating efficiency; eliminates corrections after installation. For traps and trapping assistance call your nearby Armstrong Factory Representative.

ARMSTRONG MACHINE WORKS
812 Maple St., Three Rivers, Michigan

Left—Side inlet—Side outlet traps for pressures to 250 lbs. for sizes.

Right—Forged steel traps for pressures to 1500 lbs. screwed, socket weld or flanged connections.

Left—Bottom inlet—Top outlet traps for pressures to 250 lbs. Six sizes.

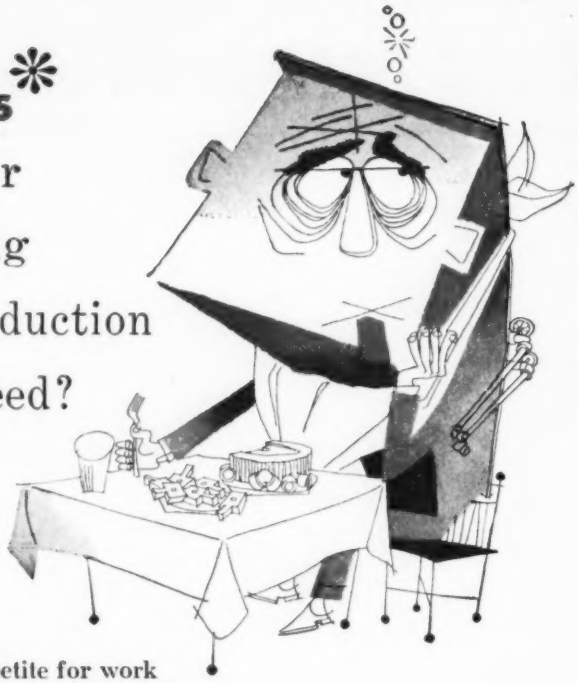
Send for the NEW 44-page Steam Trap Book—
Including 16 pages of data on how to size traps for nearly every type of equipment. Free on request—no obligation.

STEAM TRAPS

does

coil-itis*

have your processing tank production off its feed?



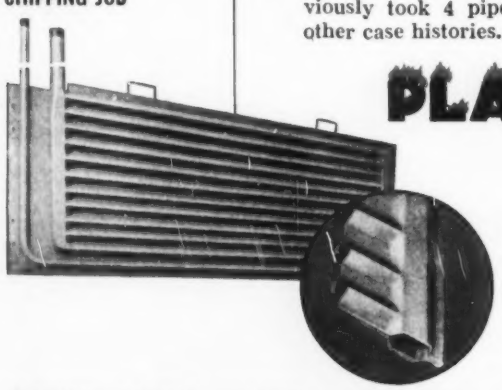
When the appetite for work of your heating and cooling processes diminishes, the trouble may well be coil-itis. For, downtime due to pipe failures and limitations can seriously delay your production flow. Switch to Platecoils, the new tonic for production, as revolutionary as the new wonder drugs. Platecoils take 50% less tank space leaving more room for greater payload. They heat or cool 50% faster. They simplify maintenance and save hours of downtime. Equally important, Platecoils cost as much as 50% less in the first place. Platecoils cure production troubles involving heat transfer and give production a shot in the arm.

Write for Bulletin P79 today!

PLATECOILS SAVE 50% IN HEAT TRANSFER COSTS

PLATECOILS ELIMINATE A 6-TO-8 HOUR-A-DAY CHIPPING JOB

At Sealed Power Corp., installation of Platecoils has completely eliminated a 6-to-8 hour-a-day chipping job. Three Platecoils now heat a tank that previously took 4 pipe coils. Ask about other case histories.



PLATECOIL

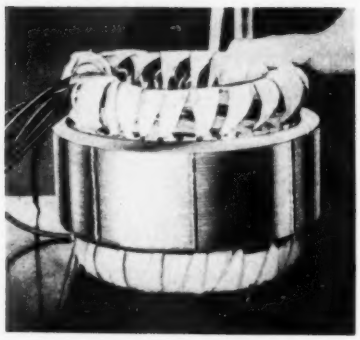
REPLACES PIPE COILS

Coil-itis — Diagnosed as tank heating and cooling problems. Platecoils — the prescription for solving pipe coil problems.

PLATECOIL DIVISION, TRANTER MANUFACTURING, inc., LANSING 4, MICHIGAN

More EQUIPMENT NEWS

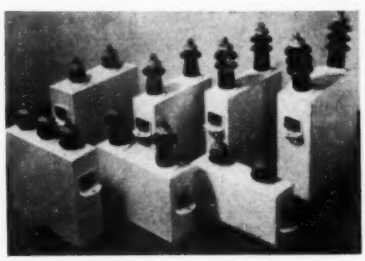
Begins on page 154



Cemented Stator Windings

1115 • New cementing and baking process affords permanent protection of stator windings against operating vibration. Special wrapping, varnish-soaking and baking processes reportedly render units impervious to constant vibrations as well as to starting and stopping shocks.

Reuland Electric Co, Alhambra, Calif.



Distribution Capacitors

1120 • New line of *Inerteen* distribution capacitors will withstand energizing at temperatures as low as —40 F. They will operate at or above industry standard ambient of 104 F without excessive losses, corona, aging, or any type of permanent change in efficiency, manufacturer claims. New dielectric fluid, solder-sealed bushings and zinc spray finish insure trouble-free operation under all weather conditions.

Westinghouse Electric Corp, Box 2099, Pittsburgh 30, Pennsylvania

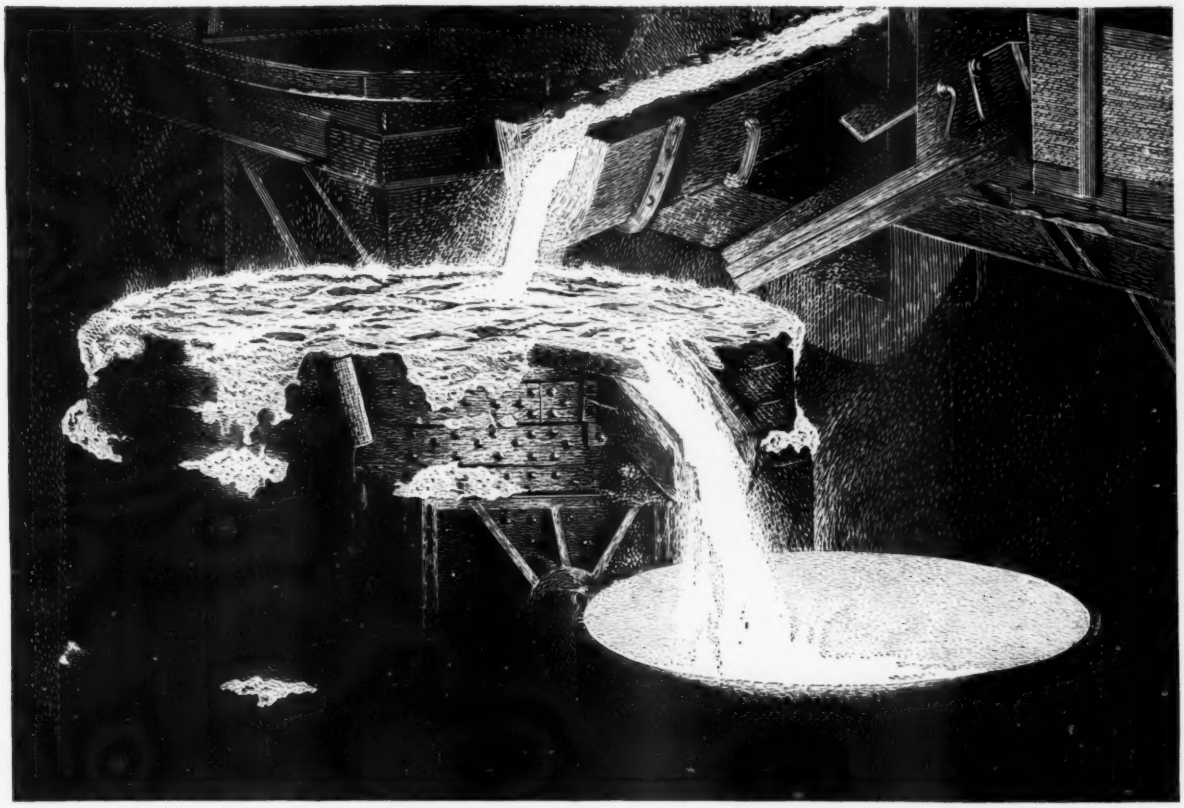
For more data on these items, use post cards p. 163. Identify your request with item number.

Gas Indicator and Alarm

1148 • Six-point combustible gas indicator and alarm sequentially samples potentially explosive atmospheres from six separate locations. Unit draws samples continuously through metallic tubing and analyzes them point by point on a 30-sec cycle. Detecting element is a platinum filament Wheatstone Bridge circuit. Presence of combustible gas shows on panel-mounted instrument while the sample line currently being analyzed is indicated by a series of pilot lights on front panel. Alarm light remains on until combustible atmosphere is dissipated or corrected.

Johnson-Williams, Ltd, 2708 3rd St, Palo Alto, California

(*Continued on page* 182)



A top steel producer reports increase:

From 220 to 330 tons per day with Cities Service Heat Prover!

Tap-to-tap time reduced from 18 hours to 12 hours! . . . Fuel cut 5%! . . . Tonnage up 50% daily! That's the amazing job the Cities Service Heat Prover helped perform for one of the country's biggest steel producers.

They were running a batch size of 165 tons, with a tap to tap time of 18 hours, using 400 gallons of fuel per hour. After the Heat Prover readings were translated into actual readjustments, TAP-TO-TAP TIME WAS CUT TO 12 HOURS, ALLOWING TWO FULL BATCHES EVERY 24 HOURS INSTEAD OF EVERY 36 . . . AND FUEL WAS CUT TO 320 GALLONS PER HOUR!

Remarkable? Sure . . . and it's the kind of a job the Cities Service Heat Prover can do wherever a furnace operation is involved by providing:

• Rapid, continuous sampling • Simultaneous reading and direct measurement of oxygen and combustibles • Easy portability • No maintenance or recalibration.

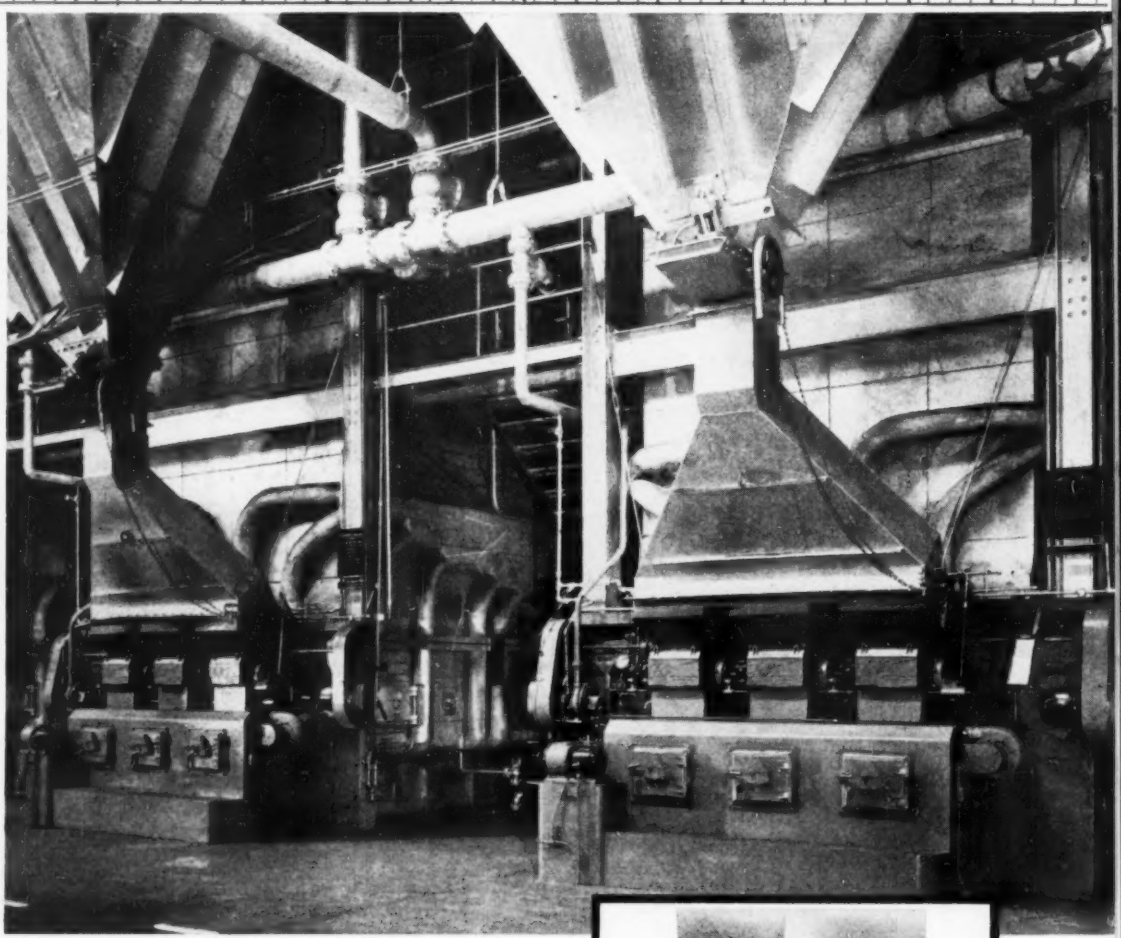
For details, contact nearest Cities Service office or write Cities Service Oil Company, Dept. K16, Sixty Wall Tower, New York City 5, N. Y.

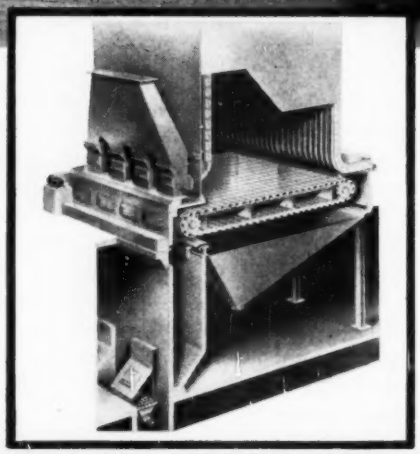
FREE—NOT AN INSTRUMENT YOU CAN BUY, BUT A SERVICE WE SUPPLY!

CITIES SERVICE

QUALITY PETROLEUM PRODUCTS

FIRST
Firite
SPREADER





This typical Hoffman installation consists of three 60,000-pound continuous ash discharge stokers. If an emergency occurs, the stokers are proportioned so that any two boilers will carry the normal plant-load of 180,000 pounds of steam.

HOFFMAN COMBUSTION ENGINEERING COMPANY

Plus Values BY HOFFMAN

You will want to investigate the exclusive features incorporated in all Hoffman Stokers for lower maintenance, higher efficiency and general overall satisfaction by owners and operators.

NO EXTRA COST

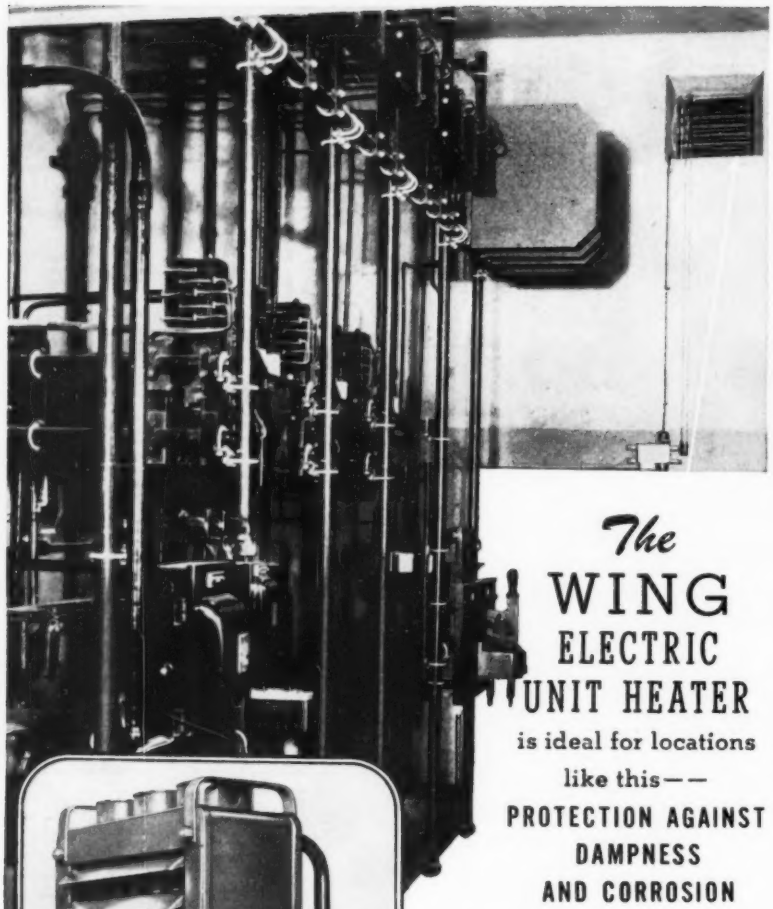
- Water-cooled, dust-sealed bearings for protection against dust abrasion and heat of conduction.
- Water-cooled gaskets between stoker front and coal feeders.
- Air-cooled exposure to radiant heat.
- Hoffman manual cam imposed between automatic controls and stoker feed, provides instant adjustment for wide changes in coal sizes or moisture content—no resetting of automatic controls required.
- Manganese quick replaceable liners on interior wearing surfaces of coal feeders.
- Hoffman special design fly ash reinjection nozzles. Fly ash conveyor pipe 300-350 Brinell, fittings 480-550 Brinell.
- Hoffman spring-loaded, throw-out clutches on each coal feeder—no shear pins.
- Hoffman special line shaft clutches and split sprockets on line shafts.
- Special hardened shafting and blades on impeller assembly.

NATION-WIDE REPRESENTATION

NEW YORK 165 Broadway	WO. 2-5744	LEXINGTON, KY. 126 Westwood Dr.	2-6206
BALTIMORE, MD. 2125 Maryland Ave.	BE. 4740	BUFFALO, N. Y. 54 N. Colvin Dr.	DEL. 8141
COLUMBUS, OHIO 1815 Oak St.	EV. 2570	NASHVILLE, TENN. 123 Third Ave., No.	6-8151
CHICAGO, ILL. 30 N. LaSalle	CEN. 6-7004	RICHMOND, VA. 615 E. Franklin St.	3-5357
BOSTON, MASS. 120 Boylston St.	DEV. 8-9483	CLEVELAND, OHIO 1655 Lauderdale	LAKE. 1-2553
INDIANAPOLIS, IND. 5217 Hinesley Ave.	BROAD. 8086	DENVER, COLO. 1351 Grant St.	AC. 3573
SYRACUSE, N. Y. 520 Robineau Road	76-9752	SALT LAKE CITY, UTAH First So. and Second West	3-5831

General Offices: **Marquette Bldg. Detroit 26, Mich.**

Works: **Fairmont, W. Va., and Detroit, Mich.**



The
WING
ELECTRIC
UNIT HEATER
is ideal for locations
like this——
PROTECTION AGAINST
DAMPNESS
AND CORROSION

The Wing Electric Unit Heater is made in three types—the Utility Heater shown above, the Wing Revolving Overhead, Downward Discharge Unit Heater and the Wing Electric Duct Heater Section. Sizes from 13,600 Btu/hr to 204,000 Btu/hr.

Write for a copy of Bulletin E-1

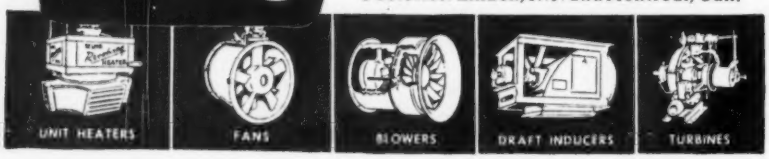
Here is a familiar problem—an underground substation, unattended, where condensation is likely to occur. The simple solution of the problem is the installation of a Wing Electric Heater (shown at the upper right) which is set in operation by a dewpoint control (shown on the wall below the heater). At the first indication of excess moisture in the air, the dewpoint instrument sets the Wing Electric Heater into operation, heating and recirculating the air in the room and removing all danger of dampness and corrosion.

Wing Electric Heaters have many applications, not only in the electric utility field, but wherever heat is necessary at remote points or where steam or gas is unavailable or uneconomical.

Wing

L. J. Wing Mfg. Co.

50 Vreeland Mills Road
Linden, New Jersey
Factories: Linden, N. J. and Montreal, Can.



More EQUIPMENT NEWS

Begins on page 154

Precision Multirange Transformer

1117 • New precision multirange current transformer covers range from 5 to 5000 a and is said to be excellent for testing other transformers for ratio-and-phase-angle errors. Above unit, P-5000, handles specified secondary burden from 0 to 25 va. By means of *Knopp One-to-One Method*, transformer can be calibrated in itself without a standard of comparison.

Electrical Facilities Inc, 4240 Holden St, Oakland 8, California

Utility Heaters

1146 • New line of utility heaters designed for mobile units and small space heating consist of three basic units and are precision built for use with 35 psi hot water or 5 psi steam systems. Fully enclosed dustproof motors provide maximum heat flow.

Young Radiator Co, Racine, Wisconsin

Miniature Circuit Breaker

1139 • Miniature permanent circuit protector, *Mini-Breaker*, fits like a fuse in any standard Edison base fuseholder and is available in 10 a rating. Device is reportedly 100% trip-free and positively will not maintain a circuit that has not been cleared of condition causing overload. Built in time lag handles temporary starting overloads and line surges.

Mechanical Products, Inc, 1824 River St, Jackson, Michigan

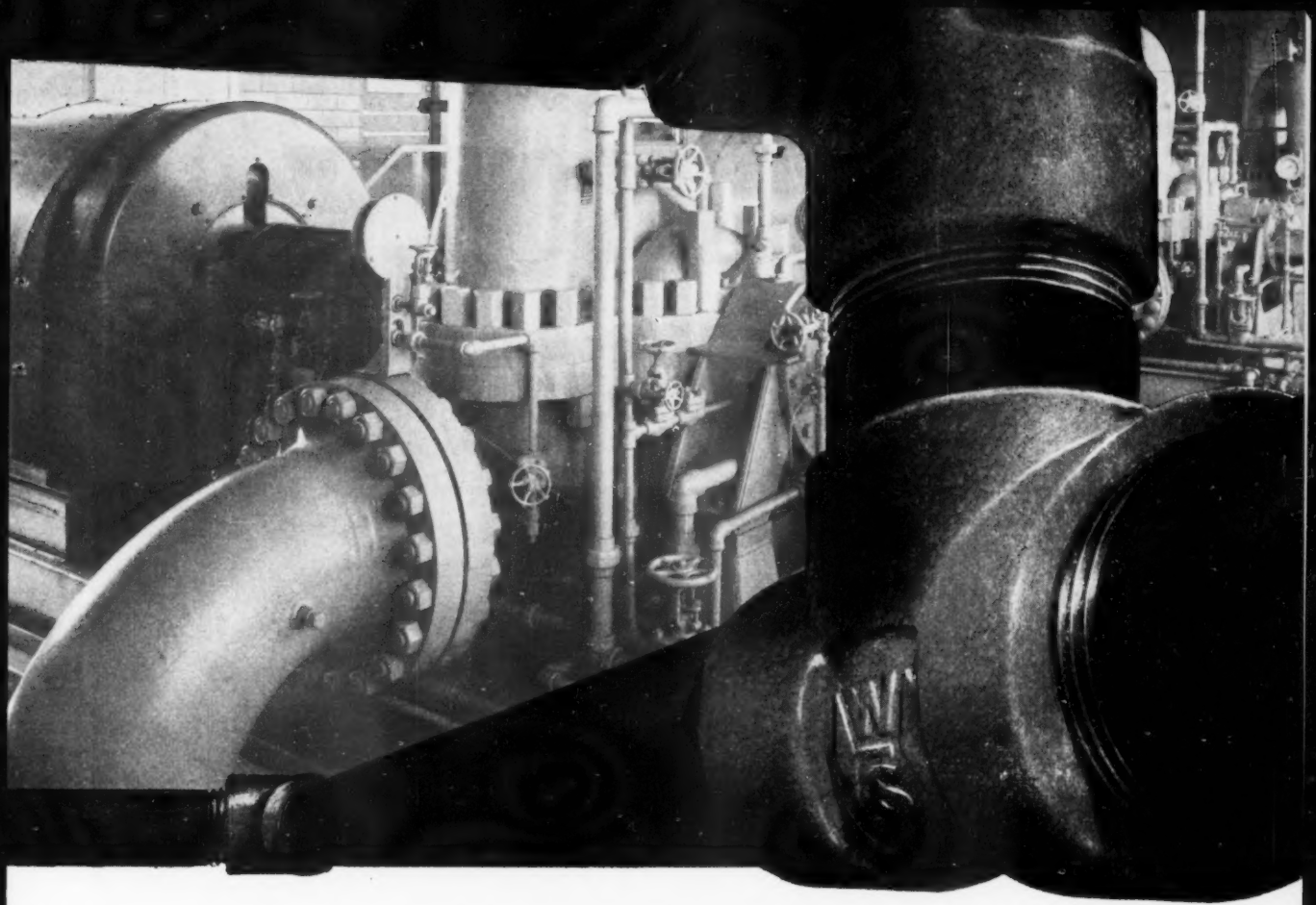
For more data on these items, use post cards p. 163. Identify your request with item number.

Circuit Breaker

1136 • New *I-T-E "J"* frame circuit breaker measures only 9x11x5½ in. yet does not sacrifice any protective features. New instrument is a thermal-magnetic circuit breaker with quick-make, quick-break operating mechanism available in ratings from 70-225 a, 2 and 3-pole, 600 v ac, 250 v dc, 15,000 a interrupting.

I-T-E Circuit Breaker Co, 19th & Hamilton St, Philadelphia 30, Pa.

(*Continued on page* 186)



In the Power Industry W-S Screw-End Fittings . . .

MORE ECONOMICAL ALL THE WAY DOWN THE LINE

FOR REAL ECONOMY on your next screwed fitting piping job specify Watson-Stillman the Double-diamond brand of Forged Steel Fittings.

You'll find their long, accurately cut threads, in perfect alignment, assure ease of installation.

You'll find their extra long bands extending well beyond the last thread, provide reinforcement at points of severest strain.

You'll find their heavy uniform fitting wall thickness provides a high safety factor to give you years of leak proof, trouble-free service.

Accurately machined . . . they fit tight and they're made of forging stock especially selected for toughness, strength, and resistance to temperature and shock. Available in carbon, stainless and chrome-moly alloy steels.

Watson-Stillman also makes a complete line of forged Socket-Welding fittings. Investigate these superior, life-of-the-system joints. Write for literature.

SOLD THROUGH LEADING DISTRIBUTORS

WATSON-STILLMAN FITTINGS DIVISION

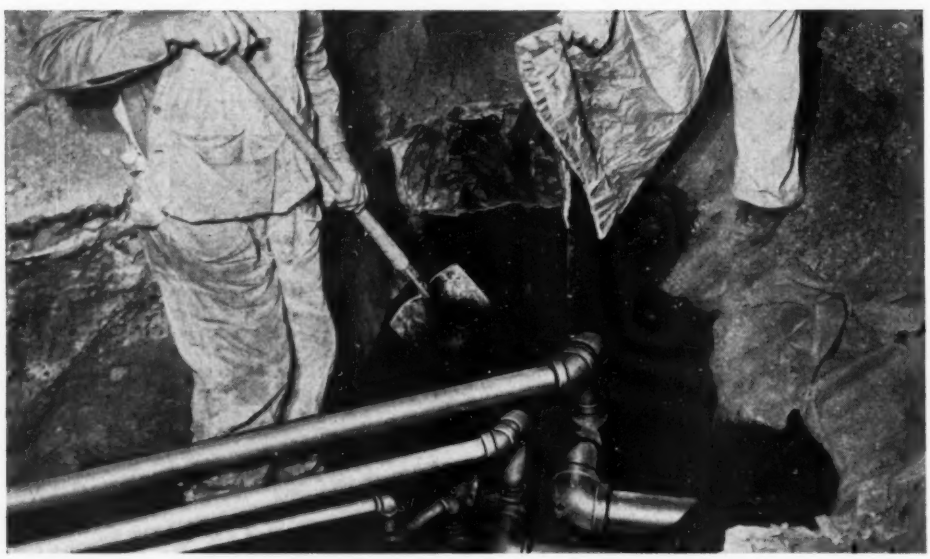
H. K. PORTER COMPANY, INC.

133 ALDENE RD., ROSELLE, NEW JERSEY

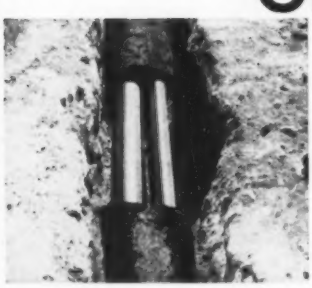
9-9-6

FROM A MINE IN UTAH:

THE DISCOVERY that practices and the cost



GILSULATE*...the triple-zone insulation



GILSULATE forms its own massive circular sheath after backfill and normal introduction of heat (up to 520° F.) through pipes.

hot underground pipes. It's water-proof,

GILSULATE—nature's own insulation—is a unique, solidified hydrocarbon. It virtually installs itself: just pour it on...tamp...backfill—the job's insulated. Normal pipe-heat (up to 520° F.) does the rest—fuses the GILSULATE to the pipe in hours, forming a massive circular sheath. Three tough layers completely protect the pipe against heat loss, against water, all types of corrosion, any commonly-encountered buried-line condition. GILSULATE came from the earth and is simply being returned to the earth, where it has laid unchanged for millions of years.

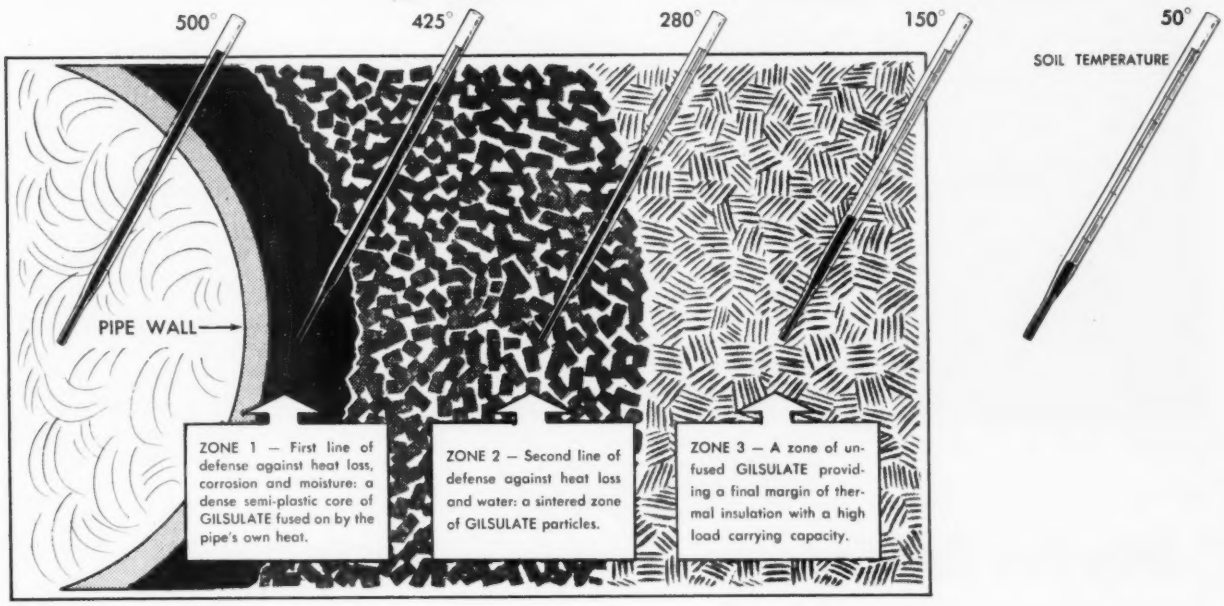
GILSULATE costs less installed per linear foot *than any other hot underground pipe installation*...it's easiest-to-use...and has been tested in scores of the country's largest and most important installations

For a demonstration, write or call your nearest dealer:

California	Los Angeles 15, Industrial Insulators, 1244 South Grand Avenue San Francisco 7, Western Fibrous Glass Products Co., 739 Bryant St.
Canada	Montreal, Engineering Equipment Co., Ltd., 874 Beaumont Ave. Toronto, Michael Stuart Co., Ltd., 116 Bloor St. West
Colorado	Denver 2, Jay and Cox, Inc., 2124 Broadway
Georgia	Atlanta, American Gilsenite Co., H. L. Armentrout, 831 Briarcliff Road
Illinois	Chicago 6, Ray O. Nelson Co., 330 South Wells Street
Indiana	Indianapolis 2, Jackson Engineering Co., Inc., 1531 N. Pennsylvania St.
Louisiana	New Orleans 6, Edgar Murray Supply Co., Inc., 232 Canal Street
Michigan	Detroit 26, John F. Wolff & Co., Penobscot Building, Rm. 702
Minnesota	St. Paul 14, Paul W. Abbott Co., 2288 University Avenue
Missouri	Kansas City 8, Anderson-Stolz Corp., 1727-33 Walnut Street St. Louis 1, Eagle Industrial Co., 119 North Seventh Street
New York	New York 7, A. F. Hinrichsen, Inc., 50 Church Street Syracuse 2, H. V. Boggs Co., 419 E. Jefferson Street
Ohio	Cleveland 6, William G. Jewett Co., 12417 Cedar Road
Oregon	Portland 4, Mead and Associates, 517 S.W. Alder St., Rm. 1100
Pennsylvania	McKees Rocks, Tutein and Bickell, 429 Broadway
Texas	Houston 11, Mundet Cork Corp., 6601 Supply Row
Utah	Salt Lake City 1, Williams, Gritton & Wilde, 204 Cooly Building
Washington	Seattle 66, Winsor Co., 20031 Marine View Drive, S.W.

* *GILSULATE is a blend of specially sized and selected Gilsonite, a unique solidified hydrocarbon of high resin content found only in eastern Utah. Gilsonite has been in use since 1887 in paints, inks, asphalt tile, storage battery boxes, etc. Its remarkable insulating properties are a recent discovery.*

can revolutionize the insulation of buried pipe installations...


500°
425°
280°
150°
50°
SOIL TEMPERATURE
PIPE WALL
ZONE 1 — First line of defense against heat loss, corrosion and moisture: a dense semi-plastic core of GILSULATE fused on by the pipe's own heat.
ZONE 2 — Second line of defense against heat loss and water: a sintered zone of GILSULATE particles.
ZONE 3 — A zone of unfused GILSULATE providing a final margin of thermal insulation with a high load carrying capacity.

that fuses itself into lifetime protection for corrosion-proof, root-proof, acid/alkali-proof

A few additional GILSULATE advantages:

- *3 grades available* covering 220°-520° F.
- *needs no sleeves* or mechanical sheaths to protect insulation
- *requires no mixing* or special handling
- *can't be punctured*—leave rocks in backfill
- *needs only normal pipe spacing*—steam and condensate lines can run side by side
- *pipe contracts and expands* within GILSULATE structure
- *repairs to pipe* are quick and easy
- *proved in actual use* in hundreds of new construction and replacement installations
- *widely preferred*—by heating, ventilating and mechanical engineers, architects, contractors in central steam installations, chemical and petroleum plants, construction projects, industrial power plants, utilities, and state institutions.

For descriptive literature, fill in the coupon below.

AMERICAN GILSONITE COMPANY
SALT LAKE CITY, UTAH
Affiliate of Barber Oil Corp. and Standard Oil Co. of California

GILSULATE can be used for replacement of old-fashioned, worn-out, or corroded insulation.

GILSULATE®

THE TRIPLE-ZONE INSULATION
FOR LIFETIME PROTECTION
OF HOT UNDERGROUND PIPES

American Gilsonite Co.
248 South Main St.
Salt Lake City 1, Utah,
or 1145 East Jersey Street, Elizabeth 4, N. J.

Please send me descriptive literature on GILSULATE.

NAME .....

TITLE .....

COMPANY .....

ADDRESS .....

an ACCO product

Why You Can Expect Longer, Trouble-Free Service

• The choice of metals used in the R-P&C Rising Stem Bronze Gate has a lot to do with its fine service record. The body is cast of high test bronze in our own foundry, the stem is high tensile rolled bronze, while the solid wedge and seat rings are nickel-alloy.

The design is important, too. The union bonnet adds strength and won't distort the valve body or threads when it is removed. Fluids don't come directly in contact with the operating threads and the rising stem shows position of the wedge. It's easy to disassemble this valve where frequent cleaning is necessary.

The **No. 716** R-P&C Bronze Gate Valve is made in sizes ¼" to 3", for 200 lbs. steam pressure at 500° F; or 400 lbs. OWG, non-shock. It is economical to buy and use.

• See your R-P&C distributor or write our Reading, Pa., office for literature

ACCO

R-P&C VALVE DIVISION
AMERICAN CHAIN & CABLE

Reading, Pa., Atlanta, Baltimore, Boston, Chicago, Denver, Detroit, Houston, New York, Philadelphia, Pittsburgh, San Francisco, Bridgeport, Conn.

TRADE MARK

R-P&C valves

More EQUIPMENT NEWS

Begins on page 154

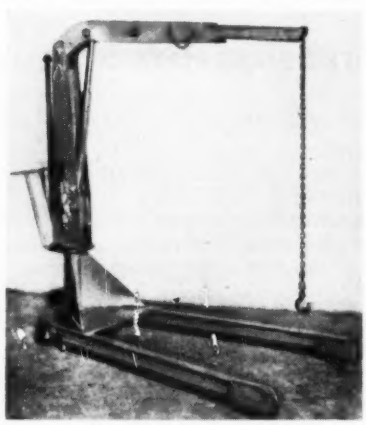
Combination Truck

1124 • Combination side-loading fork truck and load carrier can haul long bulky loads such as lumber or steel stock weighing up to 30,000 lbs in a 12-ft aisle. Since truck carries loads on inboard deck, it can travel as fast as 30 mph without endangering stability. Crane arms, rams and master pellets capable of handling multiple-pallet loads at one time are available for special jobs. Further details from manufacturer.
Baker-Raulang Co, 1230 W 80th St, Cleveland 2, Ohio

For more data on these items, use post cards p. 163. Identify your request with item number.

Sprocket Chains

1156 • New line of drive and conveyor sprocket chains replaces and supplements standard sizes of *Chabelco* line of steel chains. R and RX series are drive chains; RR series are conveyor. New series of chains will operate on standard sprockets but closer planned tolerances of press fits reportedly provide smoother operation and longer life, manufacturer claims.
Chain Belt Co, Milwaukee 1, Wisconsin



Half Ton Crane

1121 • New ½-ton crane has same features of larger models. Only 33-in. wide at base, this model has four wheels to give it added stability. Crane is noted for ease of operation, sturdiness, portability and easy conversion from shop to truck use.
Star Machine & Tool Co, Minneapolis, Minnesota

(*Continued on page* 190)

In the almost quarter century that we have been in business, we have been called upon to develop and produce many highly specialized types of expansion joints. None, however, have been more spectacular than the 109-inch joints recently developed for use in testing equipment for aircraft engine prototypes. These low pressure joints were designed with a hundred internal tie bars, which permit the joints to absorb the lateral deflection between a long exhaust header, operating at 650° F. and a series of large gas coolers, without the need for heavy anchors. Eight of these joints are now in service in a classified defense project.

This is just another example of how Zallea engineers, with the experience gained from specializing in one product—expansion joints, are able to successfully and economically solve the most difficult problems confronting this type of industry.

But this is not all—we regularly manufacture a complete line of expansion joints capable of service in virtually any type of expansion application. These joints are available in diameters from 3 inches to 30 feet for temperatures from subzero to 1600° F. . . . for pressures from vacuum to 300 psi in standard designs and up to 2,000 psi in special designs.

For full details regarding your expansion joint problems or requirements, just get in touch with us. Zallea Brothers, 814 Locust Street, Wilmington 99, Delaware.

For detailed information on Zallea Expansion Joints and services write today for a free copy of Bulletin 351.

Zallea
EXPANSION JOINTS

WORLD'S LARGEST MANUFACTURERS OF EXPANSION JOINTS

PROGRESS today in the power, processing and construction industries frequently depends upon new and varied types of heavy metal equipment.

Designing and building this equipment has long been an Alco specialty. From Tulsa to Trieste, from Pittsburgh to Palembang, Alco products ranging from 4-in. welded steel pipe to mammoth pressure vessels are giving outstanding service in all types of industrial installations.

This wealth of experience—applied by skilled engineers and craftsmen working with modern facilities—enables Alco to design and fabricate heavy equipment to meet rigid specifications.

Select your toughest heavy-equipment problem —then send it to your nearest Alco Products Sales Engineer. He'll quickly show you how Alco can produce the answer you've been looking for.

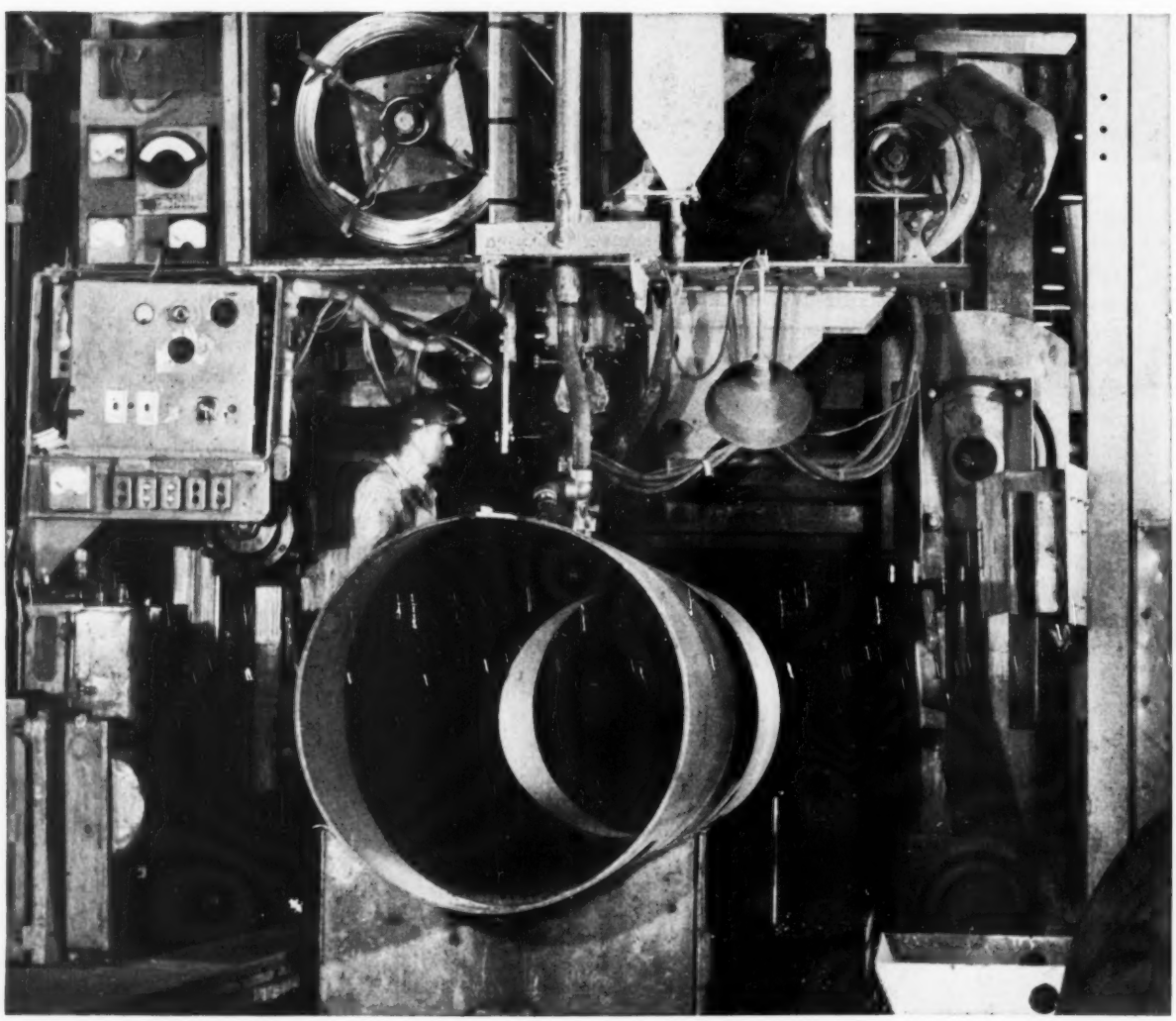
Alco Products Sales Offices are located in New York, Chicago, Dunkirk, Los Angeles, Kansas City, Houston, Tulsa and Beaumont.

Alco speeds progress in

Answers to

Alco

ALCO'S MODERN PRODUCTION FACILITIES, designed to handle economically many difficult metal-fabricating operations, include this automatic submerged-arc welding machine. Welds made on this machine must pass the most rigorous leak tests ever devised for commercial welding.



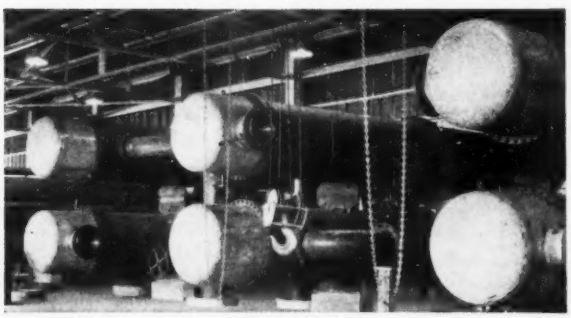
power and petroleum, chemicals and construction, with...

New Industrial Problems

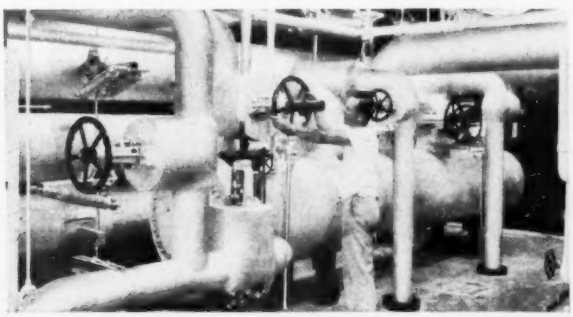
ALCO

ALCO PRODUCTS DIVISION

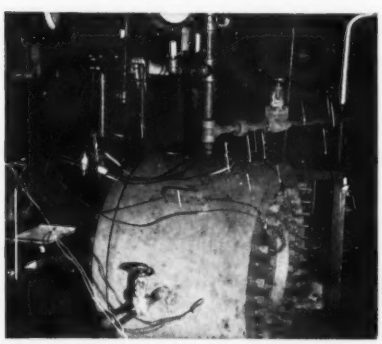
AMERICAN LOCOMOTIVE COMPANY • DUNKIRK, NEW YORK



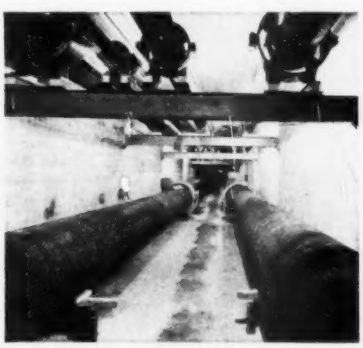
CUSTOM-BUILT HEAT EXCHANGERS ready for final piping in Canadian Chemical Company, Ltd.'s $55 million plant now under construction near Edmonton, Alberta. These units are among the more than 200 special reboilers and heat exchangers being supplied to the new Canadian plant by the Montreal Locomotive Works, Ltd., an Alco affiliate.



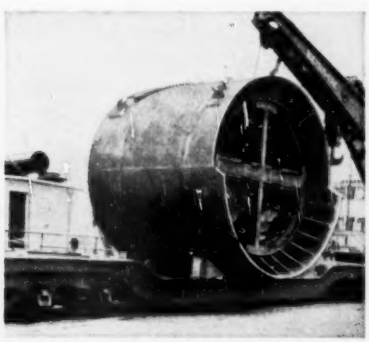
ALCO FLEX-TUBE EVAPORATORS incorporating many new features help boost efficiency at Carolina Power and Light Company's new 150,000 kw plant at Goldsboro, N. C. These specially designed Alco units produce vapor containing one part per million or less of mineral solids. Make-up to the system has been found to be less than one-half of one per cent.



NEW HIGH-PRESSURE CLOSURE, shown here during high-temperature tests, is typical of the many heavy-equipment improvements developed by Alco engineers for service throughout industry. (Reprints of article, "Engineering Development of Alco's New High-Pressure Closure," available upon request.)

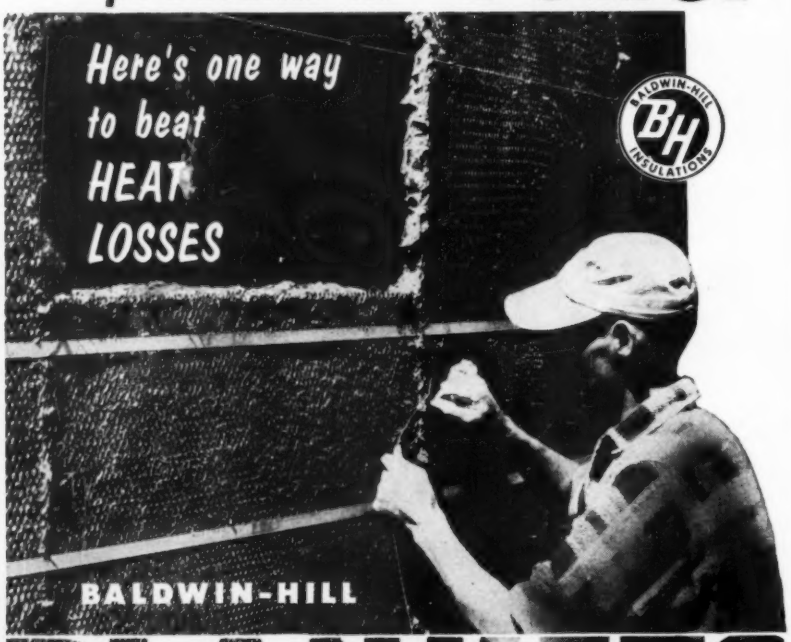


ALCO WELDED STEEL PIPE was furnished for the chilled water lines in the U. S. Government's new $4\frac{1}{2}$ million walk-through tunnel, part of a Capitol Power Plant improvement project, now under construction at Washington, D. C. The 30-in. main lines (on tunnel floor) total about 9,280 ft., branch lines about 1,200 ft.



GIANT TUNNEL SHIELDS illustrate the variety of special heavy-metal equipment designed and fabricated by Alco for power, petroleum, chemical and construction companies the world over. Other items built by Alco to meet strict specifications range from tar stills to stripping towers, cement kilns to jet-engine containers.

You find the solution to many problems in **Power**



When you lose heat, you lose operating efficiency and, what's more, those escaping Btu waste your money. Investigate the savings you can make with B-H rockwool BLANKETS. Effective up to 1200° F., they provide exceptional insulating efficiency. High temperature-resisting B-H rockwool is felted in large sheets between various types of metal fabrics to form blankets which are easily applied to large equipment. The soft fiber edges of one blanket merge with the edges of adjoining blankets to form an unbroken layer of insulation. Step up operating efficiency . . . save fuel . . . insulate with B-H BLANKETS. For the correct type and method of application best suited to your job, call on B-H Engineered Insulation Service.

HOT or COLD — IT NEEDS INSULATION

This Mineral Wool Insulation conforms to COMMERCIAL STANDARD CS-117-49 as issued by U.S. DEPARTMENT of COMMERCE

CERTIFIED BY MANUFACTURER No. 100

In cooperation with INDUSTRIAL MINERAL FIBER INSTITUTE, INC. NEW YORK • NEW YORK

Baldwin-Hill

Clip on signed letterhead and mail

TEAR OUT

BALDWIN-HILL COMPANY, 111 Breunig Ave., Trenton 2, N. J.

Please send complete information on

- ☐ **BLANKETS . . . Metal-reinforced, flexible, felted, rockwool insulation**
- ☐ **NO. 1 INSULATING CEMENT . . . All-purpose, rust-inhibiting, plastic cement**
- ☐ **MONO-BLOCK . . . Rigid, felted, rockwool block—for high and low temperature use**
- ☐ **POWERHOUSE CEMENT . . . High adhesion, rockwool, insulating-finishing cement**

More EQUIPMENT NEWS

Begins on page 154

Safety Hooks

1133 • New hook features safety gate that, manufacturer claims, will lock automatically and will not open unless pin is manually depressed. New design uses hook shank as operating base for gate yet does not obstruct throat. Units are available in sizes #2 to #16A with greater capacities available on special order.

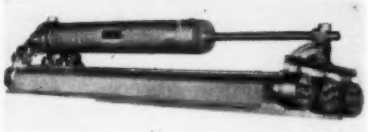
E D Bullard Co, 275 Eighth St, San Francisco 3, California

For more data on these items, use post cards p. 163. Identify your request with item number.

Heavy Duty Clamp

1142 • Cast-iron fitting employs sound engineering principle to seal pipe leaks quickly, safely and without cutting flow in system. Connector consists of two parts joined by four screws. It encloses leak within captive *Neoprene* gaskets thus forming gas-tight chamber that equalizes pressures inside and out. Fitting itself exerts no pressure on leak or weakened area and, since all contact with pipes and fittings are *Neoprene*, resulting joint will stand intense vibration. Connectors are available in a variety of sizes for both straight pipe and elbow repair.

Holoal Mfg Corp, Box 95, Bellerose 26, New York

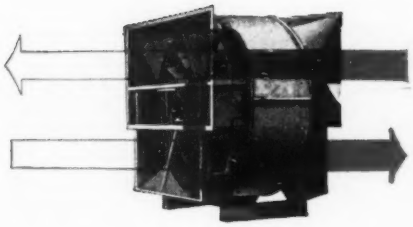


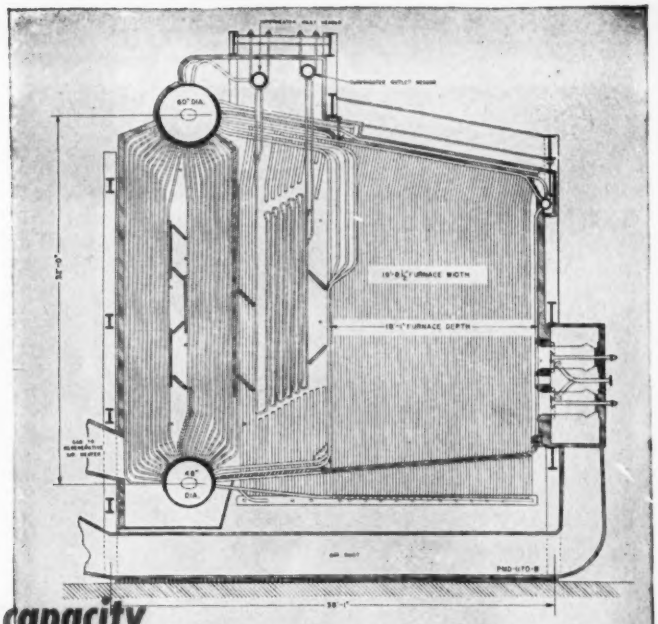
Explosion-Proof Light Fixture

1113 • Explosion-proof and dust-tight fluorescent lighting fixture makes possible continuous and uniform illumination in the presence of explosive gases or vapors or combustible ducts, manufacturer claims. Each fluorescent tube is housed in an individual tube of heat-resisting glass. Replacing tubes requires no special tools.

Crouse-Hinds Co, Syracuse 10, N. Y.

(*Continued on page* 191)





3,375,000 pounds of steam capacity at Kaiser Aluminum & Chemical Corporation

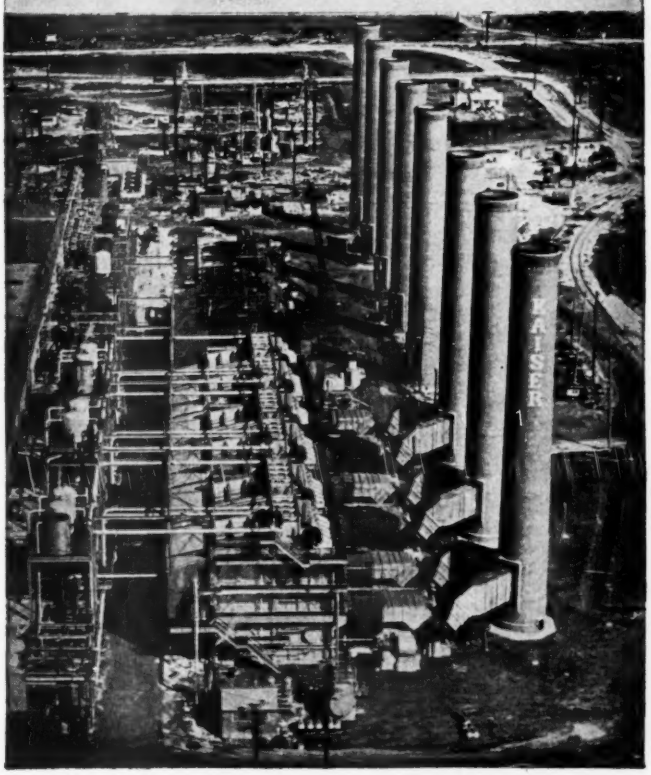
equipped with LJUNGSTROM AIR PREHEATERS

Four hundred million pounds of aluminum annually will be produced at the new Kaiser Aluminum & Chemical Corporation plant at Chalmette, La., when it is operating at full capacity. Designed and built by Kaiser Engineers, Division of Henry J. Kaiser Company, this plant will help meet the ever growing demand for aluminum products, both civilian and military.

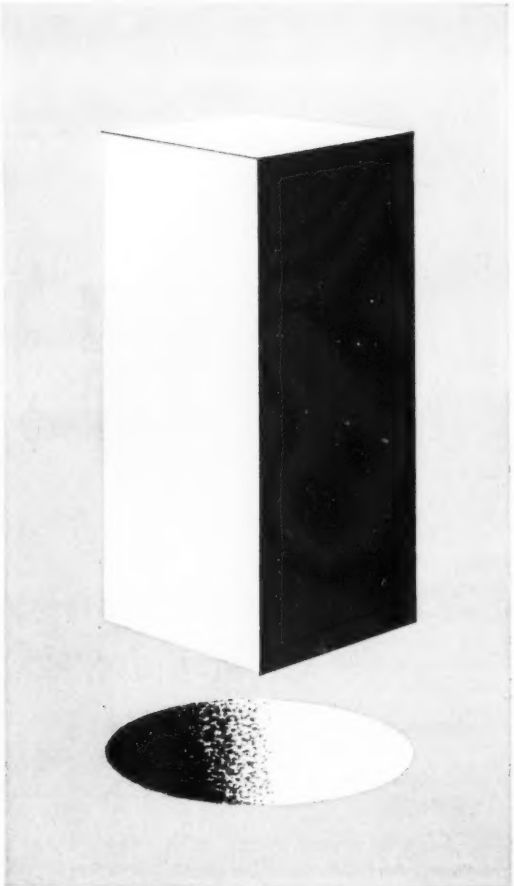
Because it takes roughly 10 kwh of electricity to produce one pound of aluminum, the electrical generating capacity at this large new plant must be enormous. Therefore, when the plant is completed, it will have a total capacity of nearly 500,000 kw, of which 375,000 kw will be steam-generated.

The plant's vast steam requirements are met by fifteen Foster Wheeler steam generators, each with a maximum continuous capacity of 225,000 lb of steam per hr at 900 psi and 905 F. Each boiler incorporates a Ljungstrom Air Preheater, which cools exit gas to 320 F, and preheats incoming combustion air to 540 F.

The Ljungstrom Air Preheater—chosen again and again where steam generation must be efficient—can serve you, too. Its wide acceptance by utilities . . . by consultants . . . by industrial plants all over the world is your assurance that the Ljungstrom is truly the most economical heating surface on the modern boiler.



THE Air Preheater Corporation 60 East 42nd St., New York 17, N. Y.



SQUARE PEGS IN ROUND HOLES

The proverbial "square peg in a round hole" is an apt description of a system of Automatic Combustion Control and Instrumentation which is not engineered correctly for your plant requirements.

Avoiding such a condition calls for versatile, durable and accurate components, plus the "know-how" acquired from experience with thousands of installations of virtually every imaginable type.

Larger boilers, operating at higher pressures than ever before, and the increasing use of multiple fuel systems, make a properly engineered instrumentation and control system an urgent necessity.

A fundamental requirement in the design of the units which comprise Hagan systems is that they must be versatile, accurate and dependable. These characteristics are built into every unit of the wide variety available to Hagan engineers for designing systems of Automatic Combustion Control and Instrumentation to fit exactly the requirements of *any* steam plant.

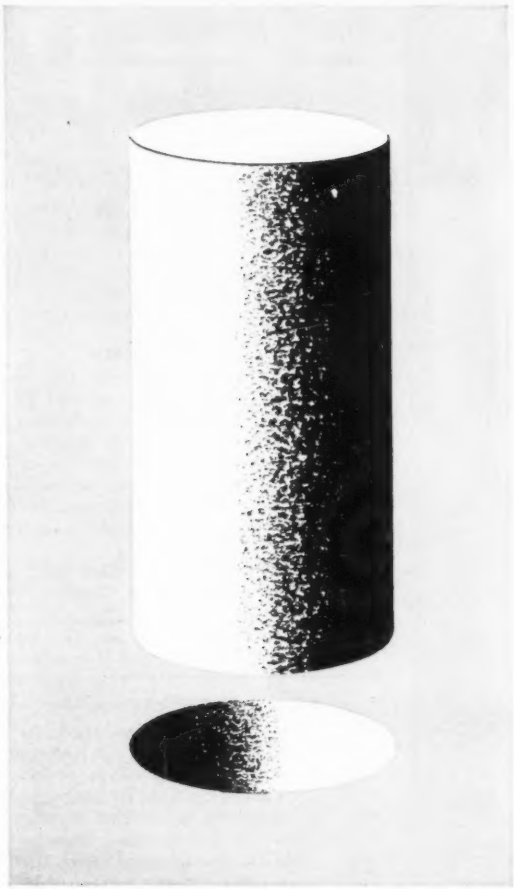
HAGAN
HALL
BUROMIN
CALGON

HAGAN CORPORATION

HAGAN BUILDING • PITTSBURGH 30, PENNSYLVANIA

BOILER COMBUSTION CONTROL SYSTEMS
RING BALANCE FLOW AND PRESSURE INSTRUMENTS

INSTRUMENTS AND AUTOMATIC CONTROL SYSTEMS



TAILORED TO FIT

For the past thirty-five years, Hagan Corporation engineers have designed systems of Automatic Combustion Control and Instrumentation tailored to fulfill the requirements of thousands of plants. In fact, for any set of operating conditions, for any size or number of boilers, for any combination of fuels, there is a system of Hagan controls in successful operation.

To implement the engineering skills derived from such diverse experience, Hagan engineers have a wide variety of versatile, accurate and dependable units from which to choose. For example, typical Hagan units are shown at right.

Whatever your requirements, in terms of pressure, temperature or load fluctuation, a Hagan System of Automatic Combustion Control and Instrumentation assures maximum combustion efficiency. Write or call . . .

METERS—To measure differentials to 560" WC at static pressures up to 3,000 psig and differentials to 140" WC at static pressures up to 15,000 psig. Accurate automatic compensation for such factors as pressure and/or temperature, level, density is a standard attachment.

CONTROL—For a continuous range of pressure from zero absolute to 5,000 psig.

POWER UNITS—for dampers and valves. Powerful, high speed, fast response.

PANEL RELAYS—for biasing, manual-automatic or ratio adjustments—and requiring minimum panel space.

HAGAN CORPORATION

HAGAN BUILDING • PITTSBURGH 30, PENNSYLVANIA

METALLURGICAL FURNACE CONTROL SYSTEMS • CONTROL SYSTEMS FOR AUTOMOTIVE AND AERONAUTICAL TESTING FACILITIES

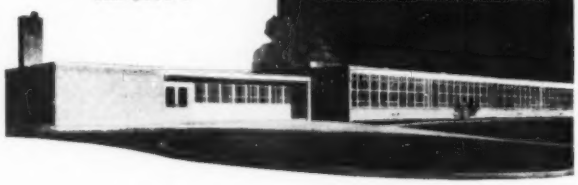
HAGAN HALL BUROMIN CALGON

MUST BE VERSATILE • ACCURATE • DEPENDABLE

COMPACT
EFFICIENT
DEPENDABLE

FOR MODERN SCHOOL HEATING

Hillendale Elementary School
Montgomery County, Maryland
McLeod & Ferrara, Architects
Washington, D. C.



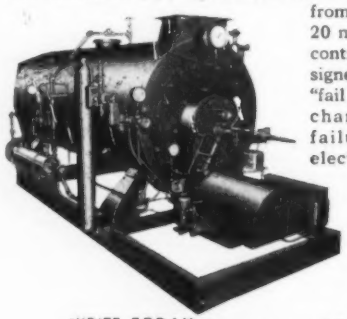
CYCLOTHERM*

CYCLONIC COMBUSTION

COMPACT . . . No extensive stack, foundation, insulation, excavation or instrumentation is required. Cyclotherm Units are delivered complete, the Contractor sets the boiler on the spot you choose and makes five easy connections; fuel, electricity, water, steam and a simple flue to comply with local codes. The Cyclotherm is the smallest fire tube boiler available for its rated capacity, which provides the architect maximum use of space.

EFFICIENT . . . The efficiency of any boiler is determined by the rate of heat transfer from fuel to useful heat. The superior advantage of a Cyclotherm Unit is due to the increased transfer of heat by radiation of the flame, the characteristic of which is controlled by Cyclonic Combustion, a patented combustion method used in Cyclotherm Units which allows a guaranteed minimum efficiency of 80% and low fuel consumption.

DEPENDABLE . . . Cyclotherm boilers give you full power from a cold start in 15 to 20 minutes. The electronic control system is so designed that the boiler will "fail safe" in case of mechanical breakdown or failure of fuel, water or electricity. Local factory trained engineers are always ready to give you immediate service and keep your boiler running smoothly.



WRITE TODAY for your copy of "All Your Questions Are Answered by Cyclotherm" and find out why Cyclotherm Steam Generators have been proven superior in thousands of installations. Just drop a post card to Cyclotherm, Dept. 24, Oswego, New York.

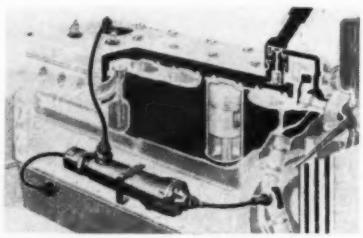
*Reg. trade name

CYCLOTHERM STEAM GENERATORS

CYCLOTHERM DIVISION UNITED STATES RADIATOR CORP.—OSWEGO, NEW YORK

More EQUIPMENT NEWS

Begins on page 154



Engine Preheaters

1101 • Electric preheater cuts cost on cold weather operation of diesel and gas engines. Device plugs into any electrical outlet and percolator-like action keeps engine ready for instant starting in even subzero weather. Catalog available from manufacturer shows typical installations and specifications for various sizes and types of engines.

KIM Hotstart Mfg Co, West 917 Broadway, Spokane 1, Wash.

For more data on these items, use post cards p. 163. Identify your request with item number.

Variable Auto-Transformer

1114 • Type 300BU *Adjust-A-Volt* variable auto-transformer features new design brush assembly. Pre-adjusted at factory, assembly maintains almost constant pressure from full-brush to no-brush assuring longer, more reliable operation, manufacturer claims. Device is suited to left and right-hand rotation and over voltage (0-135 v) or line voltage (0-115 v) operation. Maximum load rating 0.4 kva available in single or ganged assemblies.

Standard Electrical Products Co, 2240 E 3rd St, Dayton, Ohio

Gasoline Electric Plants

1127 • Two gasoline-driven electric plants, rated at 10 and 15,000 watts ac, contain following new features: impulse-coupled magneto with special radio shielding for easier starting, sliding battery rack for easier servicing, $10\frac{1}{2}$-qt cooling system and fuel consumption well under one qt/hr at full rated load. "HQ" series are available in all standard voltages, frequencies, and phases for a variety of applications.

D W Onan & Sons, Inc, Minneapolis, Minnesota

Close-Coupled Pump Motor

1140 • New close-coupled pump motors are available in sizes up to 60 hp. Designed for use with centrifugal pumps, this motor

NEW, LOW-COST EFFICIENCY

Clark DUO-STEP Leverage

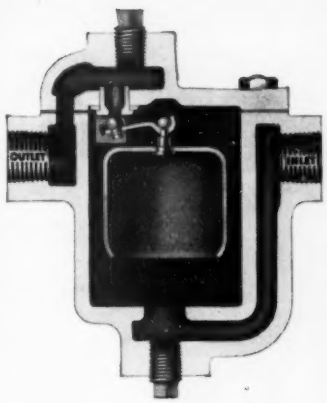
FAMOUS DUO-STEP LEVERAGE IS NOW AVAILABLE FOR THE FIRST TIME ON THESE SMALLER SIZED STEAM TRAPS. GET HIGHEST DRAINAGE CAPACITY AT LOWEST COST.

● Duo-Step is the revolutionary double fulcrum principle that affords maximum leverage to "crack" the valve from the orifice seat, teamed with "Follow-through" power that opens the orifice completely. This double action actually gives you double the drainage capacity of ordinary steam traps.

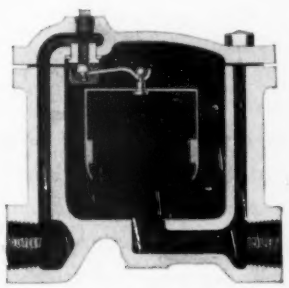
Model 60-D traps are of cast semi-steel construction, designed for pressures up to 200 P.S.I. and temperatures to 400° F. Duo-Step levers and brackets of stainless steel construction. Seats and discs are of Clark-loy. ½" or ¾" horizontal inlet and outlet connections with ¼" test outlet and drain plug. Vertical inlet can be furnished in ½" or ¾" size.

Model 70-D traps are of cast semi-steel construction, designed for pressures up to 200 P.S.I. and temperatures to 400° F. All working parts of stainless steel construction. Seats and discs are of Clark-loy. Horizontal inlet and outlet connections located at bottom of trap body for close-to-the-floor installations.

Model 70-TD for pressures to 150 P.S.I. and temperatures to 375° F. is available WITH BUILT-IN THERMAL BY-PASS at additional cost.



CLARK 60-D TRAP



CLARK 70-D TRAP

FOR COMPLETE INFORMATION CONTACT YOUR CLARK REPRESENTATIVE OR WRITE FOR *NEW* DUO-STEP BROCHURE

THE HOME OF DUO-STEP LEVERAGE

Clark

MANUFACTURING COMPANY

1830 EAST 38th STREET
CLEVELAND 14, OHIO

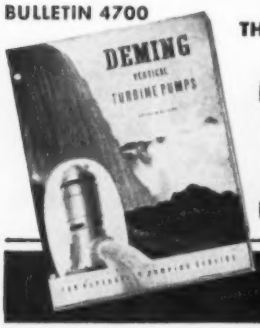
Distributors and Representatives in all major cities

MORE WATER
AT LESS COST
with a
DEMING TURBINE PUMP

Installed in 1940, the Deming Vertical Turbine Pump (illustrated above) has supplied a well-known manufacturer with millions of gallons of water with no interruptions due to pump failures. This dependable unit delivers an average of 550 gallons of water per minute from an 8-inch well, 600 feet deep and against a 110 foot head. Deming Vertical Turbine Pumps are built of standard components. Each pumping unit is individually engineered for specific operating conditions. Pumps are available in either the water lubricated type for wells from 4 to 10 inches I.D., or in the oil lubricated type for wells from 6 to 14 inches I.D. Capacities range up to 3500 gallons per minute. For complete details about Deming Vertical Turbine Pumps, consult your Deming Distributor or write for BULLETIN NO. 4700.

BULLETIN 4700

THE DEMING COMPANY • 547 Broadway, Salem, Ohio



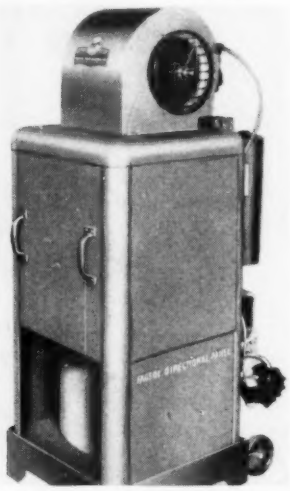
Deming
PUMPS

More EQUIPMENT NEWS

Begins on page 154

is said to eliminate shaft aligning and pump mounting problems by supporting pump on special mounting bracket. Step shaft, with special dia shoulder and tapped hole for mounting the impeller, has all ground diameters for precision assembly and sealing against leakage.

U. S. Electrical Motors, Inc, Box 2058, Los Angeles 54, California

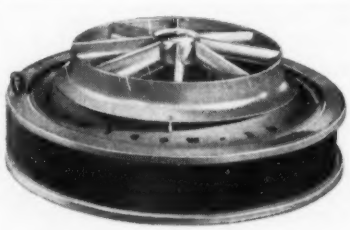


Heat Machine Panels

1125 • New side panels permit use of oil-burning heat machine in many applications where concentration of heat in one direction is required. Ordinarily, machine spreads heat in three directions just above floor. Uses include heating construction machinery, parts of buildings, valves and tanks, pipes, de-icing machinery, etc.

Fageol Heat Machine Co, 5725 Mt Elliott Ave, Detroit 11, Michigan

For more data on these items, use post cards p. 163. Identify your request with item number.



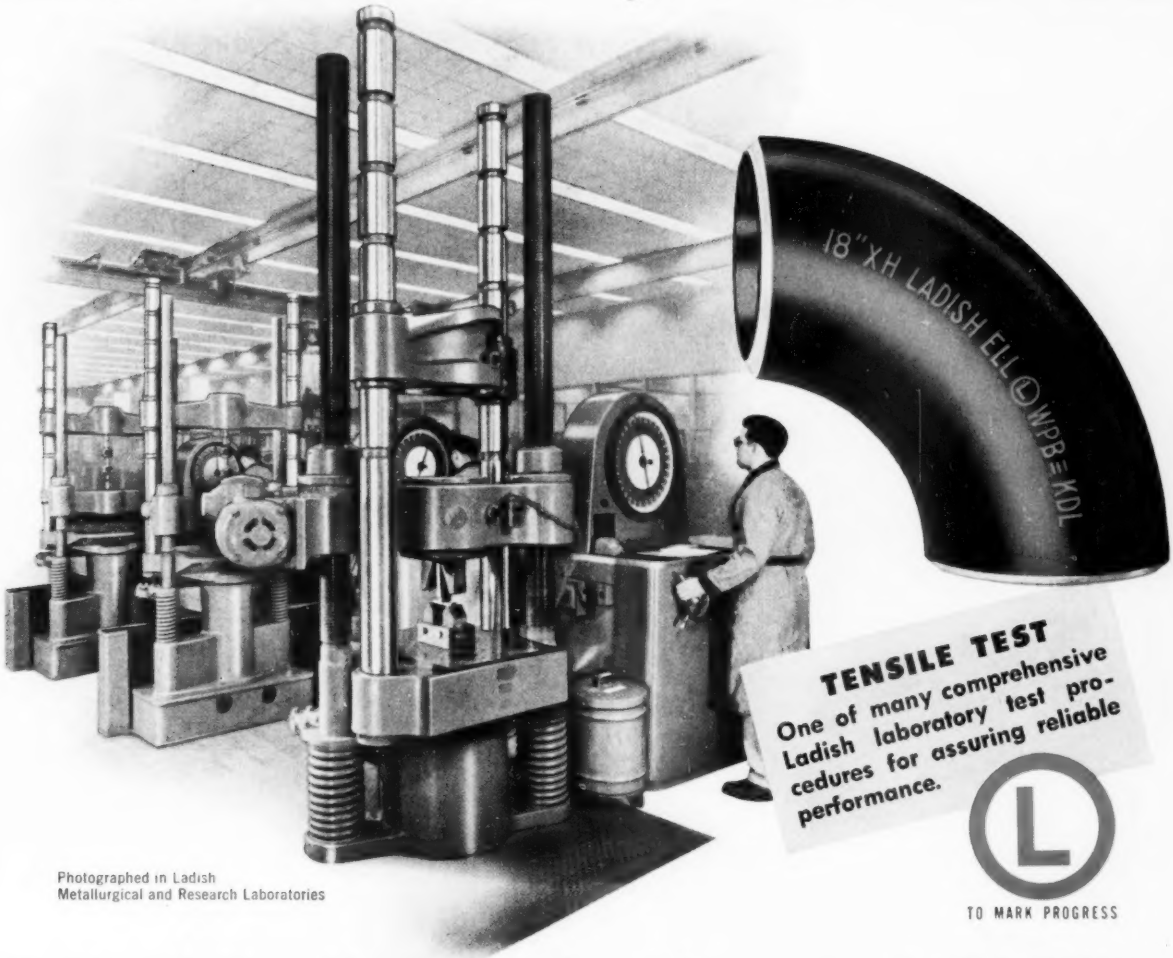
Vertical Unit Heaters

1106 • New line of vertical delivery unit heaters features light weight without sacrificing strength or durability. Largest model has capacity of 600, 500 Btu/hr and weighs only 284 lb. New heaters, with circular casings and coils, are offered in 26 models including 13 for normal steam pressures and 13 with lower outlet temperatures for high pressure steam. Bulletin 153.

Modine Manufacturing Co, Racine, Wisconsin

(*Continued on page* 200)

LADISH *Controlled Quality* ASSURES METALLURGICAL SOUNDNESS



Photographed in Ladish
Metallurgical and Research Laboratories

TENSILE TEST
One of many comprehensive Ladish laboratory test procedures for assuring reliable performance.

TO MARK PROGRESS

Testing the breaking point of metal... proves Ladish fittings have ample strength to meet the test of maximum service

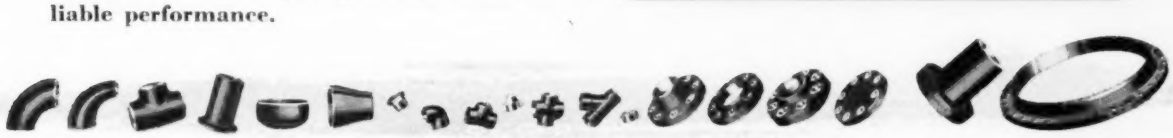
Optimum strength — proved by scientific test — typifies the outstanding values in Ladish fittings that result from special emphasis on sound metallurgy and advanced facilities. Shown here is modern Universal tensile testing equipment on which ultimate strength, yield strength, reduction of area and elastic properties are carefully measured to assure users of Ladish Controlled Quality fittings the metal quality essential for reliable performance.

THE COMPLETE *Controlled Quality* FITTINGS LINE
PRODUCED UNDER ONE ROOF... ONE RESPONSIBILITY

LADISH CO.

CUDAHY, WISCONSIN
MILWAUKEE SUBURB

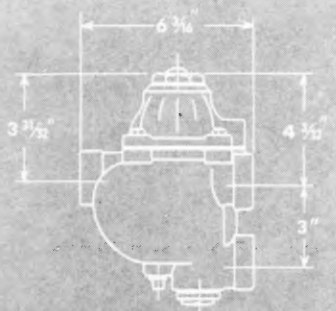
District Offices: New York • Buffalo • Pittsburgh • Philadelphia • Cleveland • Chicago • St. Paul
St. Louis • Atlanta • Houston • Tulsa • Los Angeles • San Francisco • Havana • Mexico City • Brantford, Ont.



MARSH No. 12

Float and Thermostatic Trap

Marsh No. 12, for 0-15 psi, and No. 512, for 15-125 psi, are available in either ¾" or 1" pipe size. Note two optional outlet openings.



. . . The most dependable trap you can use

There are many jobs that only a float *and* thermostatic trap can handle properly . . . and in the Marsh No. 12 you have the most respected F & T trap ever developed.

Here is a trap that counts its users in thousands. Repeat orders are the rule because men who know have discovered that no other trap can quite duplicate its absolutely dependable, trouble-free performance in removing all air and condensate from steam mains, branches, risers, unit heaters, coils, and similar applications.

Two precision-built assemblies accomplish this. All condensation is discharged by the float-operated valve located at the low point in the trap body. All air is vented through the by-pass by the action of the thermostatic diaphragm, but this is one of those Marsh diaphragms that closes the valve immediately in the presence of steam. In fact the accuracy of response is the attribute that distinguishes the Marsh thermostatic element. It gets the air out and keeps the steam *in!* Another big feature is the straight through design which eliminates troublesome excess piping.

No. 12 is your F & T trap for those low pressure applications — up to 15 psi W.S.P. but its identical-in-operation companion, No. 512, covers the working pressure range of 15 to 125 psi. There is a Marsh trap for every low or medium pressure application.

Write for catalog 76-H covering Marsh heating specialties

MARSH HEATING EQUIPMENT CO., *Sales Affiliate of Jas. P. Marsh Corporation*

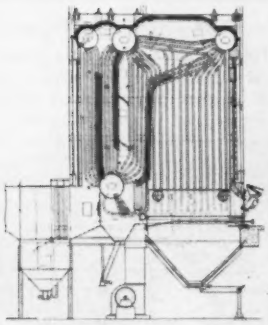
Dept. 31 - Skokie, Illinois

Manufacturers of gauges, thermostatic regulating valves, Solenoid valves, heating specialties

MARSH *Heating Specialties*

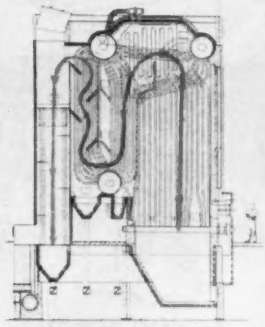
SINCE 1865

Add the Advantages...



1. VERTICAL DESIGN

+

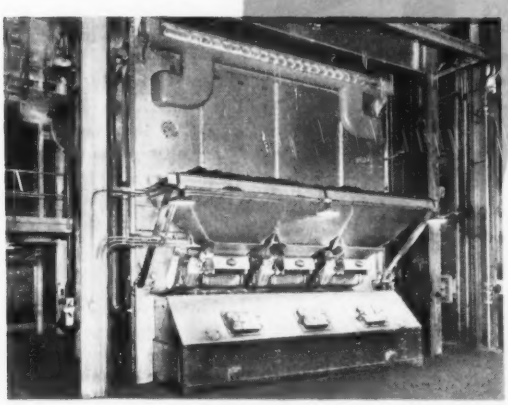


2. LONG GAS TRAVEL

=

BROS vertical water tube and baffle arrangement means less clinging of soot or fly ash. A cleaner boiler means more rapid heat transfer! BROS elongated gas travel means that all possible energy is wrung from the gas and converted to steam. Together, these advantages mean sustained high efficiency over long operating periods.

You'll Choose BROS



This is a BROS 2-drum Watertube Boiler installation at a large midwestern university. Also shown is the BROS Travl-Spred Stoker. These units are dependable parts of a plant which produces heat for campus buildings.

Before you specify your next steam generating unit, talk to a man from BROS. He can tell you concisely what a BROS-designed watertube boiler offers you. Two of the points are illustrated above. Since 1888 BROS engineers have specialized in these features which make boilers deliver the most steam for the least money in a specified application. Many of these BROS advantages are exclusive. Find out how they can serve you!

Watch for other BROS advantages to be described in forthcoming ads in this series. ADD THE ADVANTAGES . . . YOU'LL CHOOSE BROS!

BROS

Power Division: **WM. BROS BOILER & MFG. COMPANY**
1057 Tenth Ave. S. E., Minneapolis 14, Minnesota

DESIGNERS AND MANUFACTURERS OF 2, 3 AND 4 DRUM WATERTUBE BOILERS, SUPERHEATERS, AIR HEATERS, ECONOMIZERS, ACCESSORIES, AUXILIARIES, PLUS A FULL LINE OF HEAVY-DUTY STOKERS

Just listen to how one user puts SCHRAMM to work . . .

"Our Schramm 105 is operating 16 hours a day", writes H. J. Lockwood, Plant Superintendent, Mullenbach Electrical Manufacturing Company, Los Angeles, "and during the day shift is on a 75% duty cycle.

"Considering that our usage of air at the time of the installation a year ago was 15% duty cycle, you can see how we have put air to work for us".

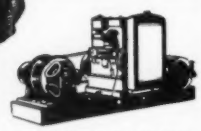
Schramm Stationary Air Compressors are chalking up similar performance records elsewhere. Users mention their "economy of operation", their "versatility", their ability to be used as a "unit system" installation.

You too will find Schramm Air Compressors offer many advantages and provide real savings. For further information on our complete line of air compressors write today.

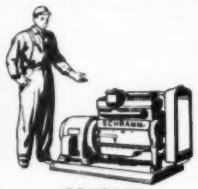
SCHRAMM, INC.

The Compressor People

WEST CHESTER • PENNSYLVANIA

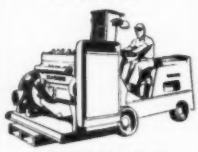


COMPLETE PACKAGE

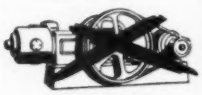


COMPACT

UNIT SYSTEM



EASY TO MOVE



ONE COST

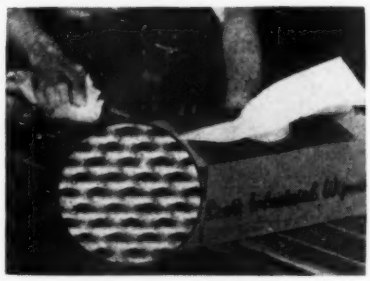
VIBRATIONLESS

LOW MAINTENANCE

LOW INITIAL COST

More EQUIPMENT NEWS

Begins on page 154



Industrial Wipers

1109 • Designed to meet general industrial wiping needs, new wiping tissues consist of two *Perf-Embossed* sheets welded together for extra durability, thorough cleaning action and maximum dirt retention. Chemical treatment provides all important wet strength, manufacturer claims.

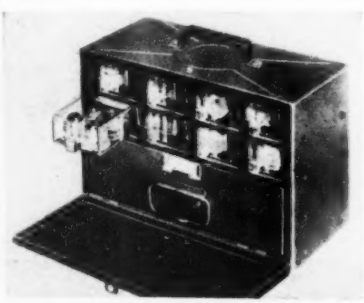
Scott Paper Co, Chester, Pa.

For more data on these items, use post cards p. 163. Identify your request with item number.

Safety Goggles

1151 • New line of cup-type goggles, trade-named *SAF-I*, includes chippers' and welders' types. Manufacturer claims new goggles feature good ventilation and light weight without sacrificing strength and durability. Lenses are of scratch-resistant plastic or hardened glass.

U. S. Safety Service Co, 1215 McGee, Kansas City, Missouri



Storage Cabinets

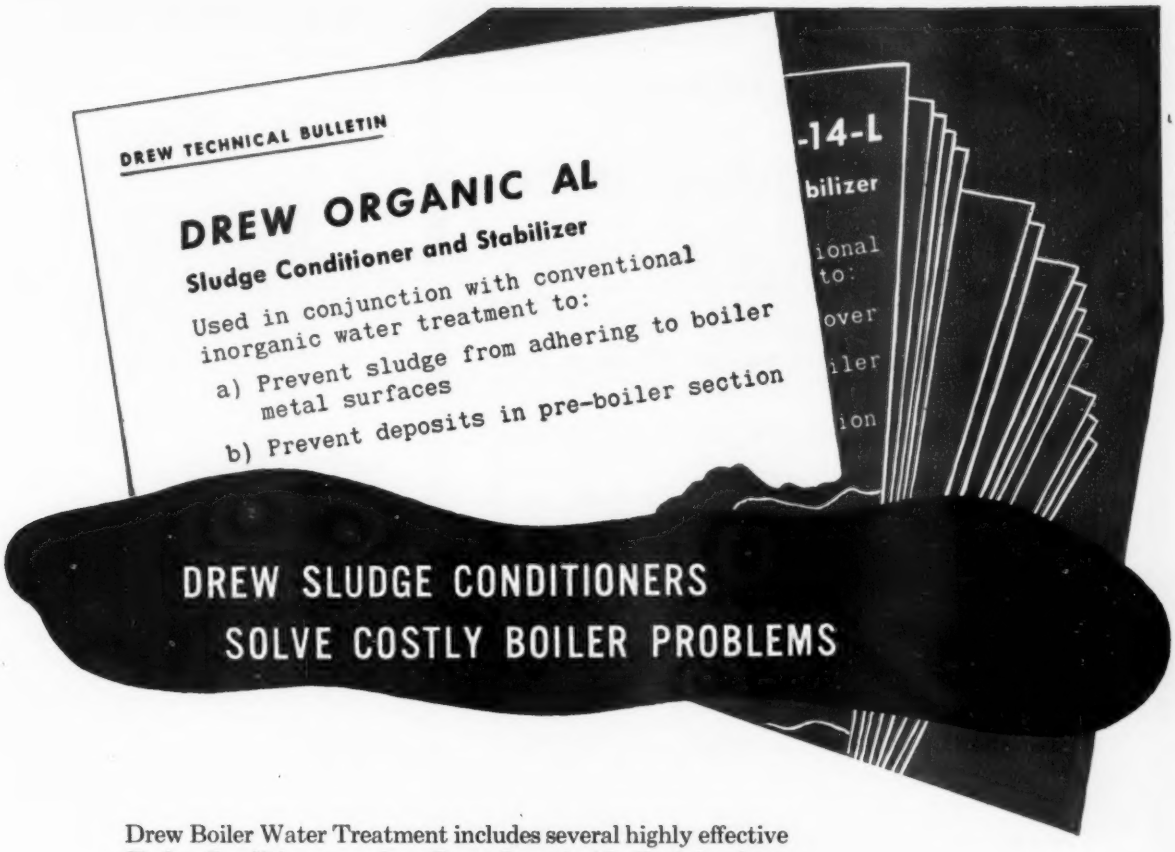
1123 • Newly developed line of *Haz-Bin* cabinets permits user to store various sizes of parts in any amount or proportion. User may select best combination for his requirements from 24 different stock models; 300 additional combinations can be custom made to meet special conditions.

Akro-Mils, Inc, Akron 9, Ohio

Plastic Tubing

1147 • Plastic tubing joined to *Swagelok* tube fittings by means of *Swagelok* inserts is reportedly resistant to chemical action and oxidation, non-contaminable and extremely flexible. Tubing is available in sizes from 3/16 in. OD up and is applicable to piping of water, gasoline and certain oils and solutions.

Crawford Fitting Co, 884 E 140th St, Cleveland 10, Ohio


DREW TECHNICAL BULLETIN
DREW ORGANIC AL
Sludge Conditioner and Stabilizer
Used in conjunction with conventional inorganic water treatment to:
a) Prevent sludge from adhering to boiler metal surfaces
b) Prevent deposits in pre-boiler section
DREW SLUDGE CONDITIONERS
SOLVE COSTLY BOILER PROBLEMS

Drew Boiler Water Treatment includes several highly effective Sludge Conditioners such as Drew Organic AL. Each has been developed to correct specific conditions in industrial water systems.

One major southeastern manufacturer was having difficulty with sludge and scaling in 13 boilers in 5 plants. Drew recommended a treatment of alkali, phosphate and Drew Sludge Conditioner AL. The entire system was cleaned up quickly and there has been no further trouble, costly maintenance or parts replacements.

To prevent or eliminate industrial water problems in your plant, you'll get results faster and more economically with this Drew program:

1. Thorough study and analysis of the problem
2. Use of effective organic and inorganic products
3. Efficient methods of feeding products to the system
4. Control of dosages by simplified plant testing
5. Service by qualified field engineers.
6. Technical assistance by the Drew Technical Department

Write for booklet "Complete Boiler Water Conditioning" and technical bulletins.

Power Chemicals Division

E. F. DREW & CO., INC.

15 East 26th Street, New York 10, N. Y.

SAN FRANCISCO CHICAGO PHILADELPHIA BOSTON DALLAS ASHEVILLE, N. C.
AJAX, ONTARIO

Service throughout the United States, Canada and South America

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5th National
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JAN. 25-28, 1954

INTERNATIONAL AMPHITHEATRE

CHICAGO

• New Ideas? You'll find thousands of them offered by more than 400 exhibiting companies at the 5th Plant Maintenance and Engineering Show in Chicago, next January.

• This is *the* show for every plant executive concerned with the machines, materials, equipment, supplies and services essential to maintaining his plant at top operating efficiency.

• Mail the coupon today for your copy of the Plant Maintenance and Engineering Show Data-Book and Tickets.

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Participate in the 5th Plant Maintenance and Engineering Conference! Top authorities will discuss plant operating problems in a comprehensive series of sessions. Conference is concurrent with the show.

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More EQUIPMENT NEWS

Begins on page 154

Dry Type Transformer

1116 • New line of dry type transformers features safety, economy and convenience. Units come in all standard sizes up to 200 kva. Special units obtainable in sizes up to 15,000 v; 1-2-3 phase; 25, 50, 60 and 400 cycles and from 25 va to 200 kva.

Hindle Transformer Co, Inc, Flemington, New Jersey

For more data on these items, use post cards p. 163. Identify your request with item number.

Safety Switches

1153 • Complete line of devices in special industry enclosures reportedly meets needs of machine tool and processing industries as well as industrial plants requiring a switch enclosure that will exclude dust, dirt, oil and coolants. Heavy code gauge steel box has cover sealed with neoprene gasket. Each installation is tailor-made without conduit openings or knockouts. Switches are available in 30, 60, 100 and 200-a ratings in 240 v ac, 250 v dc or 600 v ac/dc.

Square D Co, 6060 Rivard St, Detroit 11, Michigan

Integrator-Indicator

1143 • Miniature integrator-indicator incorporating full size integrating mechanism and standard 5-digit counter is designed primarily for mounting in graphic panels. Unit measures 6x6x14¾ in. and indicates instantaneous rate and continuously integrated measured variable. Instrument can be combined with impulse-type counter to operate shut-off or other end-point control devices after measuring a certain flow.

Fischer & Porter Co, 15 Jacksonville Rd, Hatboro, Pennsylvania

Pilot Relay Unit

1155 • New differential converter unit incorporates a pilot relay transmitter that is said to reduce air consumption to the minimum. Units are small, lightweight instruments for precise measurement of flow in industrial processes. They convert differential pressure of flow into air pressure, and transmit this to indicating, recording

for your power system . . .

KEY-KAST

Alloy Welding "Y" FITTINGS

offer GREATER STRENGTH

and LONGER LIFE

at Really Substantial Savings!

and here are the reasons WHY

- Produced by most economical method
- Increased structural strength, with greater wall thickness throughout
- Available in all shapes, sizes, schedules . . . in low and intermediate alloys and stainless steels
- Greater allowance against erosion, with extra thickness at critical areas
- Meet A. S. M. E., A. S. T. M., A. S. A. Codes
- Controlled quality . . . through rigid metallurgical control.

There's a KEY-KAST fitting
for every alloy piping need

key company

Since 1916 . . . manufacturers and developers of products for high temperatures and pressures

P.O. BOX 414C, EAST ST. LOUIS, ILLINOIS

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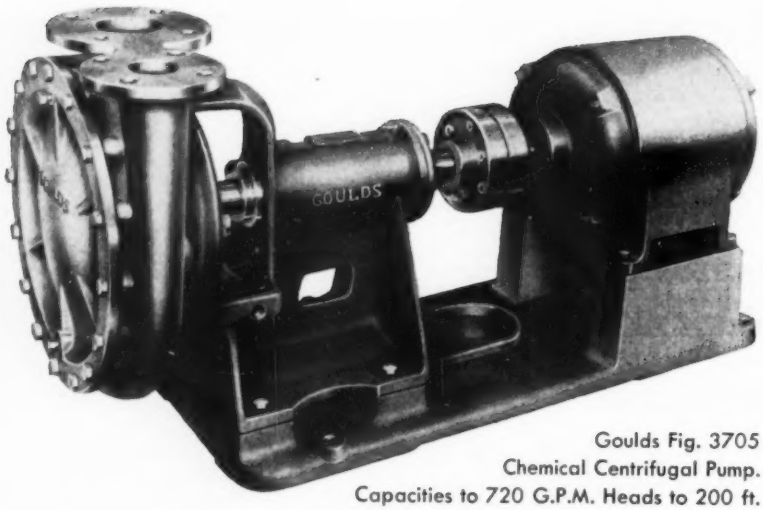

Goulds Fig. 3705
Chemical Centrifugal Pump.
Capacities to 720 G.P.M. Heads to 200 ft.

Now available in these **8 different materials!**

You know the Goulds Fig. 3705 as the pump that is saving chemical plants thousands of dollars in handling corrosive liquids such as acids and alkaline liquors.

You've asked if it could be supplied in materials other than stainless steel 316 and FA-20. Here's the answer:

You can now take your choice of these eight different materials:

1. **Stainless steel 316**
2. **Stainless steel FA-20**
3. **Stainless steel 304**
4. **All iron**
5. **All bronze**
6. **Bronze fitted**
7. **All iron, stainless steel trim**
8. **All bronze, stainless steel trim**

And you can take advantage of these four saving benefits:

a. Long packing life and freedom from leakage—Stuffing box on suction side of impeller means pressure is limited to suction head.

b. Easy cleaning and inspection—Suction and discharge connections in casing permit removal of casing cover and impeller without disturbing piping.

c. Impeller clearance adjustable for wear—By loosening and sliding end cap along shaft you expose locking collar on outboard ball bearing, permitting you to readily adjust impeller position.

d. Low parts inventory — Interchangeable parts permit you to keep inventories down and prevent excessive down-time.

To get full information on these new materials, plus performance curves, specifications and dimensions, contact your nearby Goulds representative, or clip and mail the coupon for new Bulletin 725.3.

GOULDS PUMPS, INC.
Dept. PO, Seneca Falls, N. Y.

Please send me Bulletin 725.3.

Name_____ Title_____

Company_____

Address_____

City_____ Zone____ State____

Goulds PUMPS INC. Seneca Falls New York

More EQUIPMENT NEWS

Begins on page 154

or controlling instruments. Meter bodies can stand process fluid temperatures up to 350 F; transmitter, up to 225 F.

Minneapolis-Honeywell Regulator Co. 4494 Wayne Ave, Philadelphia 44, Pa.

Vertical Scale Indicator

1166 • Compact electronic vertical scale indicator is especially suitable, manufacturer states, for applications where panel space is limited. The instrument, 6½-in. wide, saves 60% of the space formerly required by a conventional indicator. Principle feature is a rotating scale with fixed index.

Scales are illuminated with black numbers and division lines on a white drum. Twin hairlines prevent parallax error. Indicator incorporates the null-balance method of measurement. Bulletin 1541.

Minneapolis-Honeywell Regulator Co, 4494 Wayne Ave, Philadelphia 44, Pa.

Tachometer Tester

1145 • New Tachometer tester, model 110, features seven output speed shafts of 300, 500, 600, 720, 800, 1000, and 1800 rpm for testing most types of portable tachometers. Built-in reversing switch permits clockwise or counter-clockwise rotation of shafts for testing in either direction. Tester weighs only 23 lb, operates on 115 v-60 cycles and is reportedly as accurate as an electric clock.

B K Sweeney Mfg Co, 1601 23rd St, Denver 17, Colorado

Carbon Brush Changer

1167 • New brush-spring lifting device permits "from the pit" changing of carbon brushes on diesel-electric locomotives. Lifter resembles a crowbar. Socket engages tip of lever to be lifted and keeps it from snapping down should pressure on handle be relaxed. *Pry-push* action makes it possible to lift springs where no brushes are in holders. Catalog No. 9949076G1.

General Electric Co, Schenectady 5, New York

Cast Iron Welding Rods

1168 • Cast iron rods for oxy-acetylene welding provide dense welds with high tensile strength. Rods, available with flux coat or bare, contain special alloying elements that add to weld strength. Fusion temperature is not necessary in the base metal, an advantage that minimizes warping, stress, embrittlement, etc. Rods are square shaped and made in a full range of sizes from ⅛ to ⅜ in.

Eutectic Welding Alloys Corp, Flushing, N. Y.

Automatic Welding Head

1141 • New welding head features electro-mechanical control circuit that stops both head and positioner automatically if arc is broken or if electrode sticks to work piece. Motor drive is electrically independent of positioner and welder power supply.

SILICONE

ably withstands continuous exposure to temperatures up to 300° F.

Silicone gasket sheet and molded parts will easily withstand continuous exposure to temperatures up to 300° F. Where protected from the atmosphere, they will withstand continuous exposure to temperatures 300° F. to 500° F. and will withstand intermediate temperature exposures to well above 500° F. Thus it has many applications. Silicone parts are recommended for gaskets where the temperature would destroy any of the natural or synthetic rubber compounds. Especially suitable for use on refrigerants such as Freon, sulphur dioxide, liquid ammonia, etc. When ordering Silicone products, please supply full information on the use of the material so that the proper compounds may be selected.

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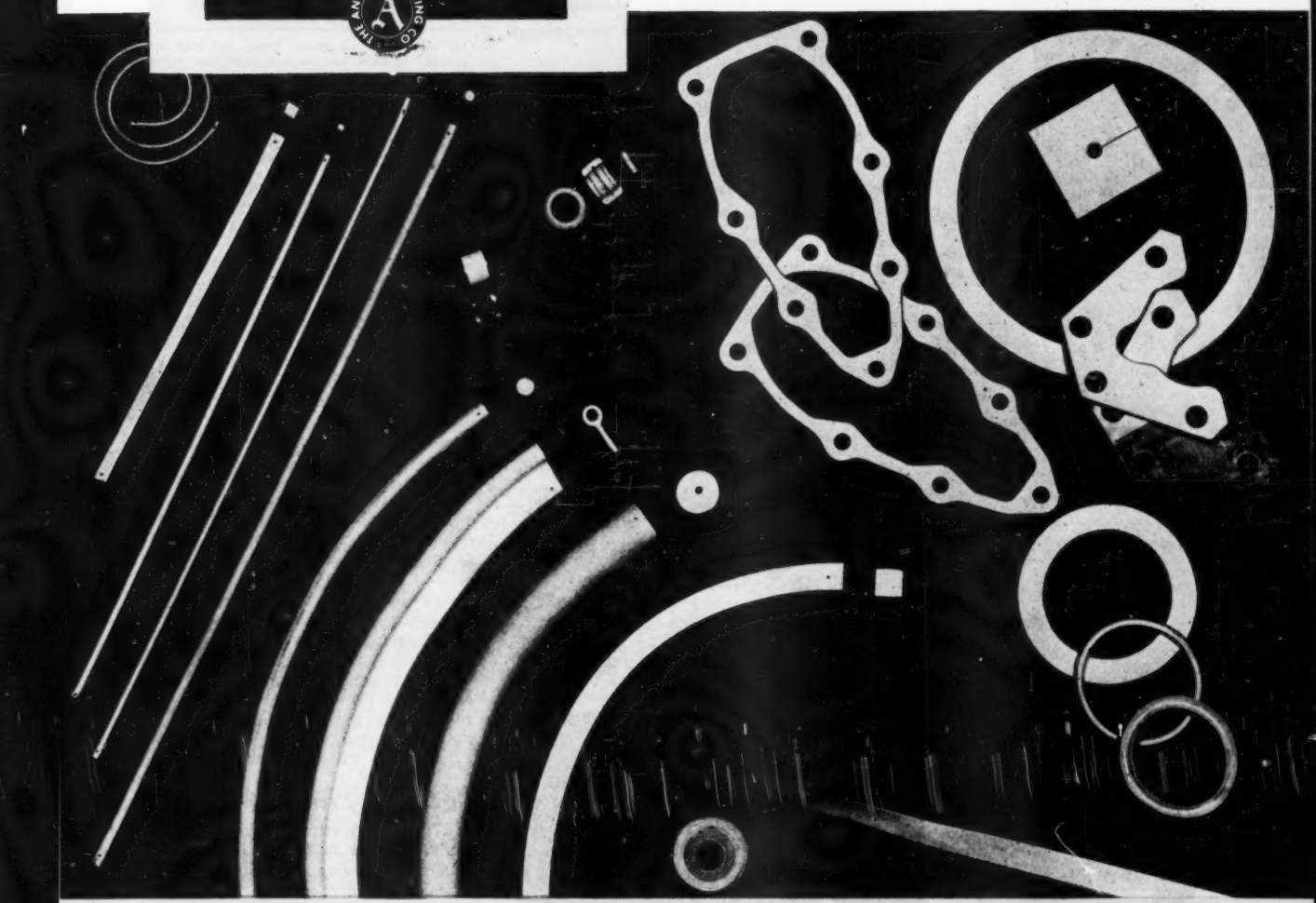
SILICONE

THE ANCHOR PACKING CO.



THE ANCHOR PACKING COMPANY

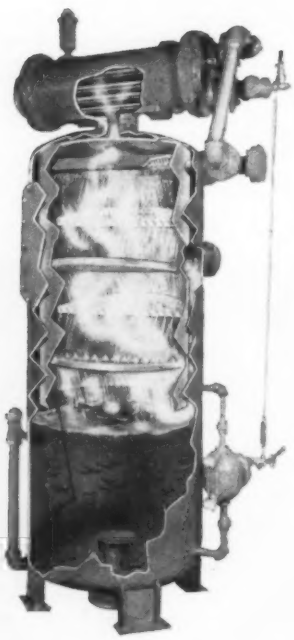
GENERAL OFFICES: PHILADELPHIA, PA.
FACTORIES: MANHEIM, PA. ELKHART, IND. MONTREAL, CAN.

FIBROUS AND METALLIC PACKINGS FOR EVERY INDUSTRIAL PURPOSE

Stop Corrosion

caused by oxygen and carbon dioxide in boilers, steam and return lines . . .

WITH NEW "SELF-CLEANING" STICKLE FEED WATER HEATER



The new Stickle Baffle Spray Type Feed Water Heater stops corrosion by removing destructive oxygen and carbon dioxide from boiler feed water . . . reduces fuel costs and boiler strain by preheating feed water.

SELF-CLEANING There are no loose baffles or trays to remove for cleaning or repair. "Self-cleaning" action takes care of small amount of lime and other minerals which may form.

OPERATION Feed water is sprayed upward against special hood, falls in mist on top baffle. Baffles are permanently installed. Semicircular, they extend in gradual slope to straight upturned serrated edge. Water cascades over edges in series of thin streams. Steam sweeps upward, carrying with it non-condensable gases. Vent condenser prevents steam waste.

CAPACITIES Capacity range in the various models is 3,000 to 300,000 pounds of preheated feed water per hour.

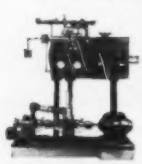
This Stickle unit is the latest development in more than 50 years of building feed water heaters. It is engineered to individual specifications, and guaranteed to obtain predetermined results. *Write for new folder S-217.*

STICKLE STEAM SPECIALTIES COMPANY
2265 VALLEY AVENUE • INDIANAPOLIS 18, IND.

Open Coil Feed Water Heaters

Open Float Steam Traps

Regulating and Reducing Valves



Differential Drainage and Boiler Return Systems

More EQUIPMENT NEWS

Begins on page 154

All parts of the head are accessible and adjustments and repairs are easily handled by the average mechanic with ordinary tools.
Mir-O-Col Alloy Co, 312 N Ave 21, Los Angeles 31, California

Stainless Steel Pump

1169 • New type stainless steel pump incorporates unique features of standard *Vanton* self-priming design that eliminates stuffing boxes, gaskets and internal check valves. Particularly adaptable to extremely corrosive service and to the handling of goods in which contamination cannot be tolerated manufacturer claims.

Pumps are available in capacities from 1/3 to 20 gpm with discharge pressures up to 60 psig and suction lifts up to 26 in Hg. Application data for service recommendations available from manufacturer on request.
Vanton Pump Corp, Empire State Bldg, New York 1, N. Y.

For more data on these items, use post cards p. 163. Identify your request with item number.

Gas Sampling Pump

1154 • New type gas sampling pump is never in contact with metal, eliminates stuffing boxes and shaft seals so there is no possibility for either contamination or leakage of gas. Pump uses eccentric shaft and rotor assembly that rotates inside and actuates a flexible liner. Gas trapped on outer liner surface and inner surface of body block is "squeezed" progressively through the pump. Capacities range from 0 to 35,000 ccpm with discharge pressures from 0 to 35 psi and suction lifts to 22 in. Hg.
Vanton Pump Corp, Empire State Bldg, New York 1, N. Y.

Hydraulic Pumps

1170 • Hydraulic pumps, fluid motors and transmissions with rotating piston design may be used as pumps or fluid motors interchangeably. Units are instantaneously reversible with equal performance in either direction of rotation.

As pumps, displacements are 60, 120 and 180 gpm at 1000 psi continuous, 1500 psi intermittent. Built in gears allow direct connection at 1200, 760 or 472 rpm. Used as fluid motors, units have ratings up to 300 hp and 19,000 lb-in. of torque at 1100 rpm manufacturer claims.
Berry Division, Oliver Iron & Steel Corp, Pittsburgh 22, Pa.

High Pressure Filter

1137 • High pressure liquid and gas filters in standard units are available for operating pressures up to 1000 psi. Pipe sizes for inlet and outlet connections are ⅜, ½ and ¾ in. Guaranteed degrees of filtration through *Micro-Klean* cartridges are 10, 25, 50 and 75 microns. Construction is of all welded steel with the head piece machined from bar stock.
Cuno Engrg Corp, Meriden, Conn.

Certified Smokeless Detroit RotoGrate Stokers . . .

At Capital City Products Co. (Columbus, Ohio)

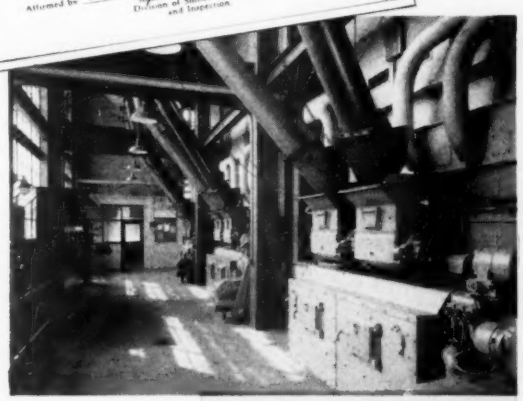
AWARD
Certificate
OF
Merit
THE CAPITAL CITY PRODUCTS COMPANY — WEST FIRST & PERRY STREET
is awarded this certificate
for having operated fuel burning equipment in the
CITY OF COLUMBUS, OHIO
FOR YEAR 1952
Within limits as set forth in Ordinance 228-49
governing smoke emission
Chairman Citizens Committee
Attested by
Smoke Regulation Engineer
Division of Smoke Regulation and Inspection
The Columbus Chamber of Commerce

This Detroit RotoGrate Stoker has been certified smokeless by the City of Columbus, Ohio. This certificate awarded by the Citizen's Committee, and affirmed by the Smoke Regulation and Inspection Division is proof of performance.

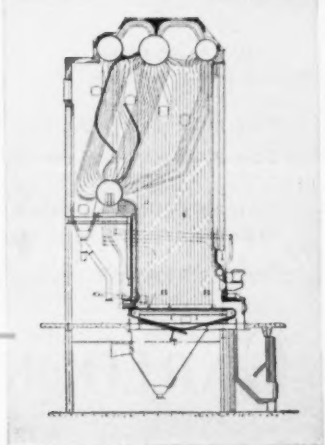
Detroit RotoGrate Stokers operate without smoke because of their many features of design including precise control of fuel feed, grate speed and air supply.

RotoGrate is a modern spreader stoker with grates that move slowly forward discharging the ash at the front. They burn any type of Bituminous Coal or Lignite . . . handle rapidly fluctuating loads with uniform pressure over long periods.

Have you a smoke problem? Or a problem of fuel cost? Ask for details on the RotoGrate. No obligation.



Detroit RotoGrate Stokers in the plant of Capital City Products Company, Columbus, Ohio.



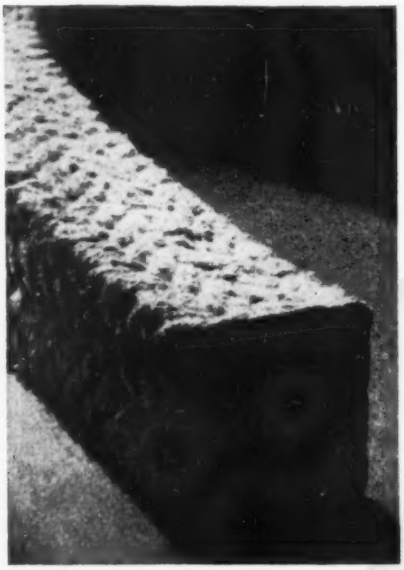
DETROIT SINCE 1896 STOKERS

DETROIT STOKER COMPANY

General Motors Building · Detroit 2, Michigan

Works at Monroe, Michigan • District Offices in Principal Cities

Braided through and through for longer service, less maintenance!



GARLOCK LATTICE BRAID* PACKINGS

APPLICATIONS

On rotating shafts, reciprocating rods or rams, expansion joints and valve stems

TYPES OF SERVICES

Water, oil, solvents, acids, steam, gases, etc., at temperatures up to 700° F.

AVAILABLE MATERIALS

Asbestos (Canadian or Blue African)
Asbestos—wire reinforced
Flax
Cotton
"Teflon" or asbestos with "Teflon" impregnation

AVAILABLE FORMS

Ring, coil, or reel

Every strand of LATTICE BRAID packing passes diagonally through the body of the packing to form a completely unified structure—braided internally as well as externally. This patented LATTICE BRAID method has these advantages:

1. Prevents the packings from disintegrating when subjected to wear.
2. Makes the packings flexible so they can be formed into rings without distortion.
3. Allows us to control porosity so that the right amount of liquid is absorbed for lubrication.
4. Imparts a semi-automatic action to the packings. This eliminates the need for frequent gland adjustments.

For complete information send for LATTICE BRAID Folder AD-131. Write the nearest Garlock branch or to our main office.

THE GARLOCK PACKING COMPANY, PALMYRA, NEW YORK

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GARLOCK

PACKINGS, GASKETS, OIL SEALS,
MECHANICAL SEALS,
RUBBER EXPANSION JOINTS

MARMADUKE

Begins on page 142

I got acquainted with the operator, Frank Peeler. That afternoon I told Frank my plans for melting out that paraffin. But I let him know that it was a two-man job and also that it would have to be done *after* midnight.

"Frank was skeptical but after we polished off a bottle of Sandpaper Gin at the local bar that evening, he was with me.

"At midnight Frank and I entered Pratt's stable. We unhitched one of his horses and led him down the street to St Mary's Presbyterian Church. Winding steps that weren't too steep lead up to a belfry with a railing around it.

"We blindfolded the nag and started him up those steps. At first he balked, but after Frank pulled on his halter from his bow—while I did some pretty good convincing from his stern—he finally got the idea and arrived in good shape. But it wasn't easy.

"Next morning all hell popped loose. The day broke beautiful and clear. Then the first early riser, one Jed Koster, passed the church on the way to his shrimp boat as he had done for years. But this morning he heard the unmistakable neighing of a horse—not from the usual direction of Joshua Pratt's stable—but from directly *above* the Church.

"Jed looked up, blinked his eyes, then turned white as a ghost. He quickly glanced up again, as if dreading to look. Yep, there was the horse all right, looking majestic as the brilliant morning sun lighted up its red hide and mane. The horse was gazing peacefully out over the town from his noble perch, no doubt waiting for Pratt's colored boy to bring him his oats.

"Jed opened his mouth as if to say something, but no sound came out. Then, mopping the cold sweat from his brow with a red bandana, he walked slowly toward Pratt's house. He turned every few steps to look up at the belfry. By golly, it *was* a real live horse—and it *was* in the church belfry.

"Before long Jed returned with the tall, lanky Pratt in tow. By then things were really buzzing. A handful of people had gathered already and there was much yelling and holiering. Everyone was staring up openmouthed. Only the horse was calm. From his unique perch he even seemed to enjoy all this hubbub.

"After Pratt blew a few fuses, flipped his lid, stripped a gear or two and blew a high-pressure gasket for good measure, he realized there was nothing to do but get that critter down. But he

LIMITORQUE®

...the most widely used
AUTOMATIC VALVE OPERATOR
in the world

Thousands are in operation, day and night in many of America's Leading Central Stations and Private Power Plants, from Maine to California—and too, thousands of LimiTorques are in constant use in Chemical and Process Plants; Water and Sewerage Plants; Oil Pipe Lines and Refineries—and aboard Ships.

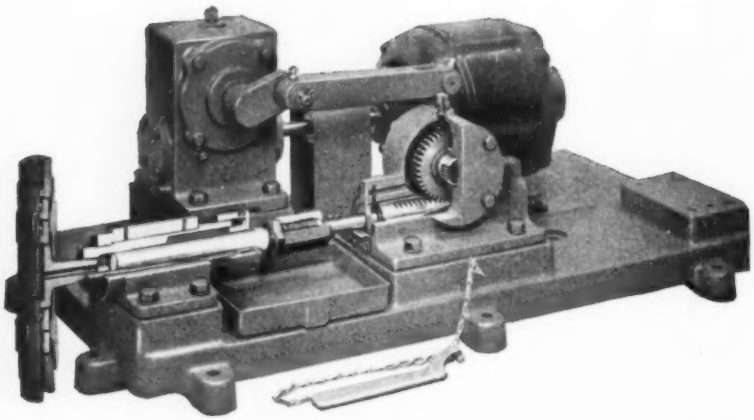
There are *many and good reasons* why LimiTorque is *by far* the most *widely used Valve Operator* in the World. . . . Write for Catalog and you'll be convinced.

Philadelphia Gear Works, INC.

ERIE AVE. AND G ST., PHILADELPHIA 34, PA.
NEW YORK • PITTSBURGH • CHICAGO • HOUSTON • LYNCHBURG, VA.

Industrial Gears and Speed Reducers
LimiTorque Valve Controls

For continuous, precisely controlled injection of boiler feed water treatment



. . . the HILLS-McCANNA "U" Type Proportioning Pump

The Hills-McCanna "U" Type Pump is designed to continuously meter and proportion small flows of the order of 0.10 to 24 gallons per hour per feed. Its accuracy and reliability ideally suit it for power plant applications such as the continuous injection of internal phosphate treatment and sodium sulphite oxygen scavenging in feed water treatment. Design of the pump is such that it may also be used for batch operations where this is preferred.

The "U" Pump is ruggedly and simply designed for long, dependable service and is furnished as a "packaged" unit, complete with motor, drive and pump mounted on a common base. Available with one to four feeds.

The new "U" Pump Catalog, UP-52, gives full information on the "U" type pump plus extensive application data including specific service recommendations for handling over 300 substances. Write for your copy, today. HILLS-McCANNA CO., 2369 W. Nelson St., Chicago 18, Ill.

HILLS-McCANNA

metering and proportioning pumps

Also Manufacturers of: Saunders Patent Diaphragm Valves

Force Feed Lubricators • Magnesium Alloy Sand Castings

MARMADUKE

Continued from page 208

soon learned that getting a horse down from a steeple took more engineering than running an ice plant.

"By then every man, woman, child and dog in St Mary's had gathered around the church. This was the biggest local news since pirates unloaded their unholy cargo on the beach in 1812. Only Frank Peeler and I weren't there. We were melting out that paraffin.

"Now that the big attraction was at the Church, I could do my stuff without being disturbed by Pratt. With all three compressors running, I closed the cooling-water to the condenser. The head pressure began to climb. The normal head pressures in summer were around 900 psi. After running all morning with no cooling-water, the head pressure reached 1245 psi.

"That's when Frank left the plant. He had a lot of faith in me, but without being braced by Sandpaper Gin, this was a little too much. If the plant was going to blow up, he was satisfied to hear it from a safe distance.

"I opened the oil separator as the temperature climbed and started blowing out melted paraffin. At the same time, I kept adding new arctic oil to the compressor. That was the secret to making this a safe operation—adding good oil as bum oil was removed.

"After about six hours, no more paraffin returned to the large suction oil-separator. Besides, the head pressure had just about reached the popping-off pressure for the compressors' safeties. So I cracked the condenser cooling-water slightly.

"After running all three compressors for another four hours under normal conditions, the cold storage-box temperatures dropped enough to cut out one compressor. And by next morning, one machine carried the load.

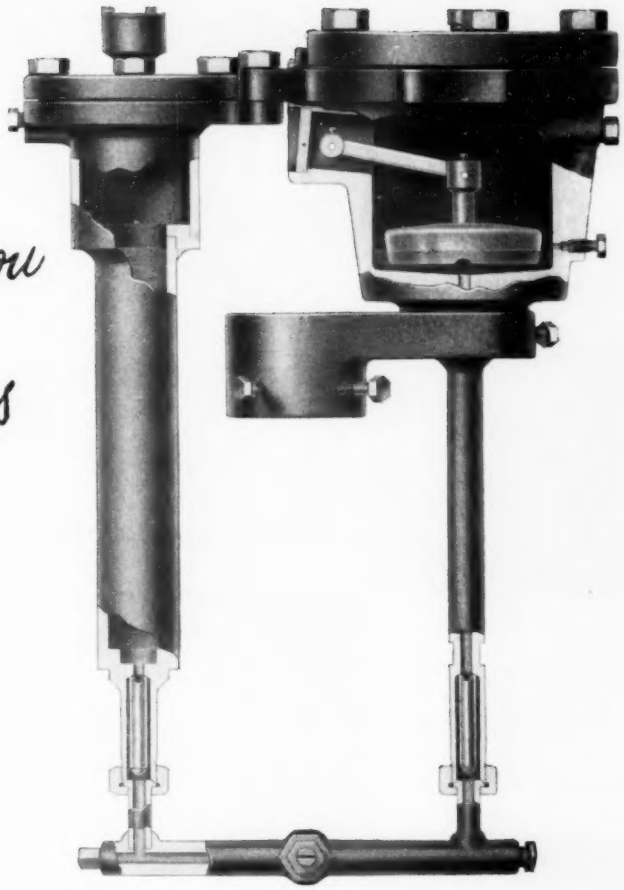
" 'What was going on at the Church all this time?' asked Marmy, downing another mug of beer and looking around at his tensely waiting audience. 'Well,' he said, answering his own question, 'it was almost midnight before excitement died down, for it took that long to get that horse back to earth. And it wasn't until the next morning that Pratt showed up at the plant. He seemed a little haggard and shaky, even after a night's rest.'

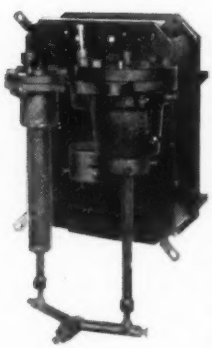
" 'All your temperatures are up and there's only one compressor running,' I informed him. 'And all the paraffin is out of the condensers.'

" 'How did you do that?' he asked, blinking his eyes and bobbing his adam's apple again.

" 'By taking your advice and using horse sense,' I answered." —*SME*

Taylor Mercury Manometer gives you continuous ranges from 10" to 533" of water!





AND no piping changes are necessary when changing from one range to another, because there are six interchangeable range tubes (10″, 20″, 50″, 100″, 200″ and 400″ of water). All except 10″ range may be over or under-ranged 33⅓%. Instrument has pressure connections both at side and top of manometer; a union coupling prevents distortion of bearing housing . . . eliminates binding or friction caused by wrench torque; when necessary for recording two Flows or for Ratio-Flow control two manometers can be mounted on the back of a single case.

NOTE THESE ADDITIONAL FEATURES:

Great power—thanks to extra big float with extra long travel. Microfinished shaft with Teflon bearings "float" this power right through to the pen.

High accuracy—inherent straight line calibration.

Positive actuation—high energy output. Big 3 5/16″ float. Long float travel—1″. Simple lever system. Teflon in pressure-tight bearing surfaces for efficient use of power. Jewelled thrust bearing.

Dependable performance—submerged check valves give positive shut-off. Unique damping valve adjustable under full pressure without leakage. Ample room in mercury chambers to accommodate surges or pulsating flows. Teflon holds pressure, yet lets shaft turn freely, giving long service.

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Instruments for indicating, recording and controlling temperature, pressure, flow, liquid level, speed, density, load and humidity.

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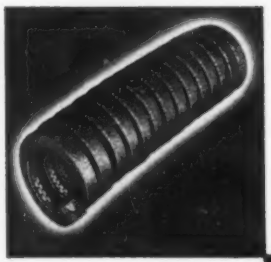
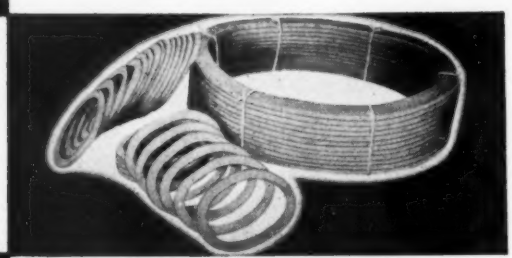
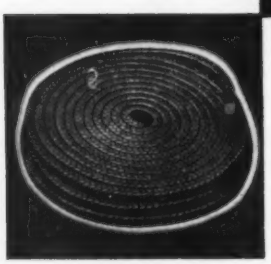
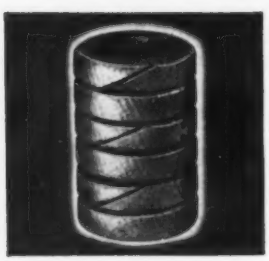


the name to look for in Packings and Gaskets







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HYDRAZINE

Continued from page 93

ent, hydrazine binds not only the oxygen but also any carbon dioxide that may be left after deaeration.

So it is possible, and this is of interest particularly for high-pressure plants, to get along with a very small quantity of hydrazine, a few mg per l to bind the carbon dioxide, if any, in addition to the oxygen. Thus salt content in the boiler water is kept very low. Further, it constitutes at the same time a means to reduce the alkalinity, as caustic soda need not be added. This, in turn, dispenses with a further addition, such as ammonium sulfate, for destroying alkalinity in the boiler, as indicated above.

Some recent experiments we came across on the reaction of oxygen with hydrazine were conducted as follows:

The flask contained a hydrazine solution of known content. Through this solution, oxygen was passed at different temperatures. Decrease in hydrazine content after different times and under the effect of different additions was noted, Table I, p 92.

Small quantities of manganese, present in most water supplies, accelerate the reactions in Table I. Other catalysts have been tested, but manganese proved the most efficient.

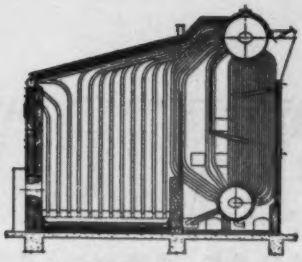
Also, several corrosion tests were made.

A beaker was charged with 1000 cc of condensate, and a bare sheet of iron placed in it. Then air, washed twice with 20% sodium hydroxide solution to remove CO_2, was passed along the iron sheet. As a measure of the resultant corrosion, Table II, the increase in iron content in condensate was determined.

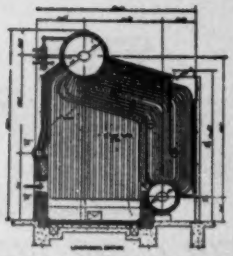
Under these test conditions, Table II, a small amount of sulfite in the condensate exerts very little corrosion inhibiting effect. Much higher additions are required. On the other hand, the protective effect of the hydrazine exists as long as it is present. Probably the oxygen going into solution reacts much more rapidly with the hydrazine than with the iron, whereas the reaction with sulfite is slower, at least at relatively low concentrations. According to these experiments it should be possible to stop stagnant corrosion completely in a boiler by adding a relatively large amount of hydrazine. For protracted shutdowns it would be necessary to check periodically for the presence of a hydrazine residual.

For some time, various users have been adding to the boiler feedwater after degassing about 2 to 2.5 mg per l of hydrazine, with the result that failures in the preheater pipes have stopped almost completely.

An experiment with a polished iron



2 Drum Water Tube Boiler



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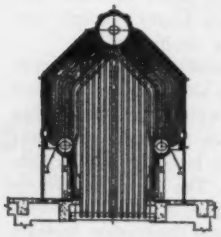
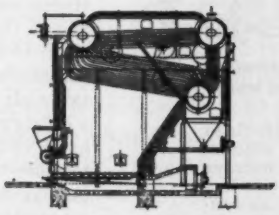
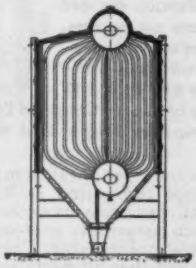


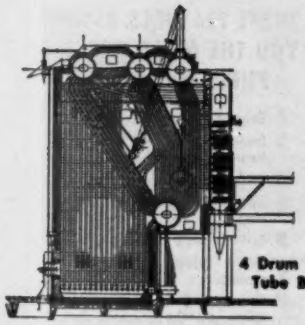
"A" Type Water Tube Boiler



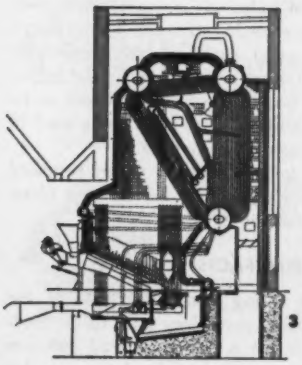
3 Drum Low Head Water Tube Boiler



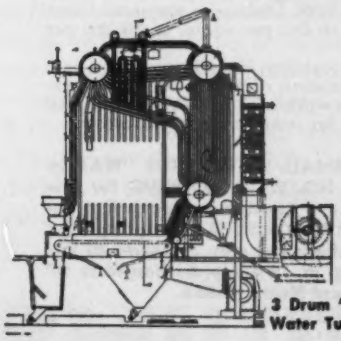
Wickes 2 Drum Waste Heat Installation



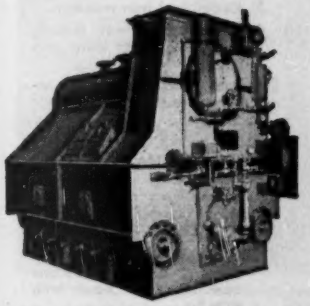
4 Drum Water Tube Boiler



3 Drum Water Tube Boiler



3 Drum "B" Type Water Tube Boiler



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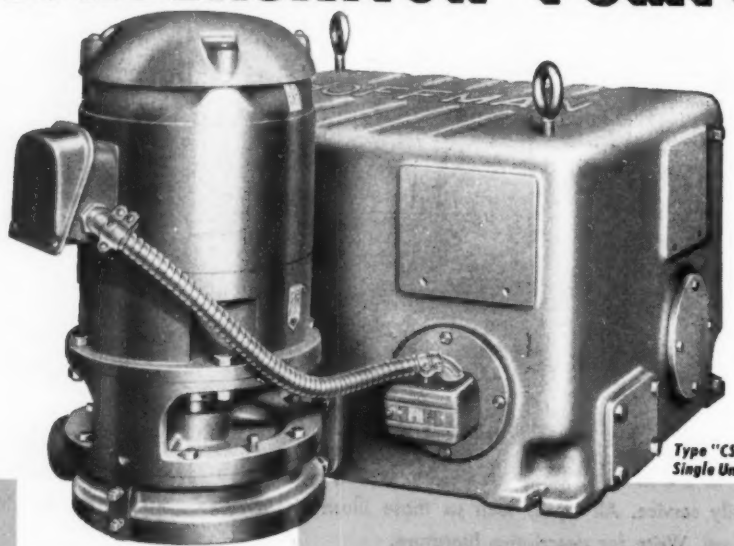

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3. Stainless steel impeller hub.
4. Renewable bronze wearing ring.
5. Split bronze packing gland.
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7. Standard ball bearing motor, 40°C continuous duty, with ample overload capacity.
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9. Heavy duty float control, seamless copper float and brass rod.
10. Impeller has top suction inlet—eliminates air or vapor binding.
11. No piping between pump and receiver.
12. Float switch adjustable to various water levels.
13. Rigid motor support, very quiet.
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HYDRAZINE

Continued from page 212

rod in the feedwater stream gave a good indication of the water's oxygen content. Corrosion of the iron rod was reduced greatly after an addition of hydrazine.

These results were also investigated analytically and the residual oxygen content determined by photometric methods. As these methods are not easily operable in the presence of hydrazine, the water must be subjected to a bromine pretreatment (according to the known procedure of Alsterberg) to destroy the excess hydrazine.

A year ago, one German industrial at Frechen decided to add hydrazine to the locomotive feedwater (condensate) in such quantity that 10 to 20 mg per l could always be observed in the boiler water. The good results were obvious in the various boiler inspections. The pipes remained perfectly clean and showed no pits, such as those that occur from corrosion due to the presence of dissolved oxygen. A steam tube examined recently showed no deposit of scale or the slightest corrosion on the side exposed to water. In fact, it could not be distinguished from a new tube.

To summarize, the following advantages and disadvantages can be cited for hydrazine as a chemical degassing agent as compared with sulfite or sulfurous acid: (1) Reaction with the dissolved oxygen proceeds to completion. (2) Only nitrogen and water are formed in the reaction. (3) Amounts of hydrazine required are much smaller. (4) Hydrazine hydrate leaves the salt content in the boiler unchanged.

(5) In high-pressure plants with condensate feed, the addition of hydrazine raises pH of the water, thus eliminating a separate addition of alkali, which has to be neutralized later by adding ammonium sulfate. The entire control is thereby greatly simplified. (6) Use of concentrated liquid hydrazine hydrate is convenient, as it requires no dissolving tanks or pressure bottles. (7) The concentrated solution is stable and does not decrease in strength when stored in the usual carboys. (8) Hydrazine accumulations do not occur in the superheaters because hydrazine as well as its salts are volatile. (9) It can be used in forced-circulation boilers.

Data for this German report supplied by Mitterlungen der Virenungen Gosskesselbesitcer, 2, 70-73, 1948.

HYDRAZINE FACTS

When using hydrazine hydrate for eliminating corrosion gas from feedwater, inject a highly diluted solution into the system after the deaerator. Injection at this point is desirable since it reduces the hydrazine hydrate require-

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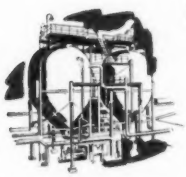
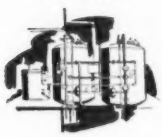
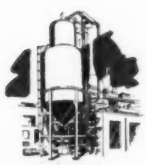


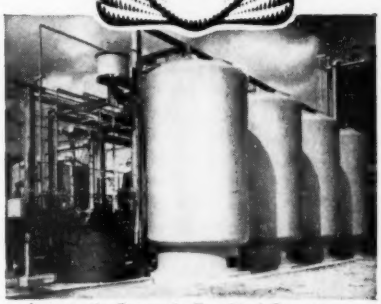
Sludge Blanket Hot Lime Soda



Hot Zeolite-Permutit Q



Deaerating Heater



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HYDRAZINE

Continued from page 214

ment to a minimum.

Chemical Test. To test for small amounts of hydrazine in water chemically, you need as apparatus: 50-ml burette, motor stirrer, 250-ml beaker, 50-ml volumetric pipette, 100-ml graduated cylinder; as reagents, standard KIO_3 solution—0.0020N, HCl concentrated, wool-red 40-F indicator—0.20% aqueous solution.

The standard iodate solution is made by dissolving 3.567 grams of pure, dried KIO_3 in 1000 ml of distilled water. This gives a 0.1000 N solution.

To standardize this solution, pipette 25 ml of potassium iodate into a glass-stoppered Erlenmeyer flask containing 20 ml of 10% H_2SO_4 and 5 ml of saturated KI solution. The reaction proceeds rapidly and the solution may be titrated immediately with standard 0.1000 N sodium thiosulfate solution using starch as an indicator.

Take 20 ml of the standardized 0.1N KIO_3, dilute it in a volumetric flask to 1000 ml using freshly boiled distilled water, and you get a 0.0020N KIO_3 solution. This solution, if carefully prepared, need not be standardized: 1 ml 0.0020N KIO_3 = 0.00001068 gm N_2H_4.

Test Procedure. To 50 ml of water in a 250-ml beaker, add 55 ml of concentrated HCl and 3 drops of 0.2% aqueous solution of wool-red indicator. Place stirrer and burette in position, start stirrer and titrate slowly with the 0.002N KIO_3 in increments of 0.5 to 1.0 ml. Allow about 8 to 10 seconds between additions of the KIO_3. Stirring should be vigorous but should not whip air into the solution. Continue titrating until the pink color of the solution starts to lighten, then reduce the increments of KIO_3 to a drop or two, until the solution turns practically colorless, which is the endpoint.

The solution should be between 3 and 5 normal in HCl at the endpoint. Temperature of the solution being titrated should not be less than 30 C. Usually the heat of mixing the HCl and sample is enough to keep the solution at 30 C. Calculation: ppm N_2H_4 = ml KIO_3 × Norm. KIO_3 × 5.34 × 20.

Potentiometric Titration. If desired, you can use a potentiometric titration. In this case the electrodes are platinum and calomel, and the meter a Beckman Model H-2 pH meter. The millivolt scale (0-800) is used. The electrodes are standard Beckman platinum and calomel electrodes with a Beckman No. 700 adapter for the platinum electrode. Titration conditions are as given above. The ml of KIO_3 are plotted against the millivolt reading. At the endpoint there is a sudden jump of 60 to 80 millivolts per 0.20 ml of KIO_3. At the first addi-

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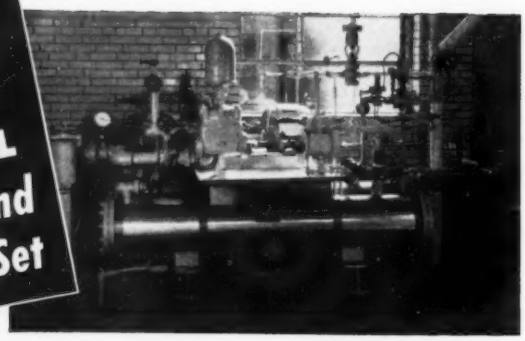

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3. Individually designed to meet the specific needs of the power plant.
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E

HYDRAZINE

Continued from page 216

tion of KIO_3 there is a rise in potential, after which it changes very little until the endpoint is reached, when the sudden rise occurs.

Amperometric Test. Hydrazine in concentrations too low for accurate chemical determination can be detected by the following simple amperometric instrument. The detector may be used to activate a sensitive relay, and through this to control alarms, valves or ventilators. The instrument is virtually insensitive to high concentrations of ammonia, but is sensitive to certain other reducing gases and to high concentrations of acid gases.

The pH should be high for two reasons. When high (1) it is not changed by the presence of ammonia (2) hydrazine is at its greatest reducing activity. The film, therefore, should be continuously replaced with fresh sodium hydroxide solution. Conductance of the circuit is constant, and should be relatively high, requiring a diaphragm of sufficient porosity.

The effect of normal room-temperature variations is unimportant.

Directions for constructing this amperometric instrument may be obtained by writing to Mathieson Chemical Corp, Mathieson Building, Baltimore 3, Md.

STEEL MILLS

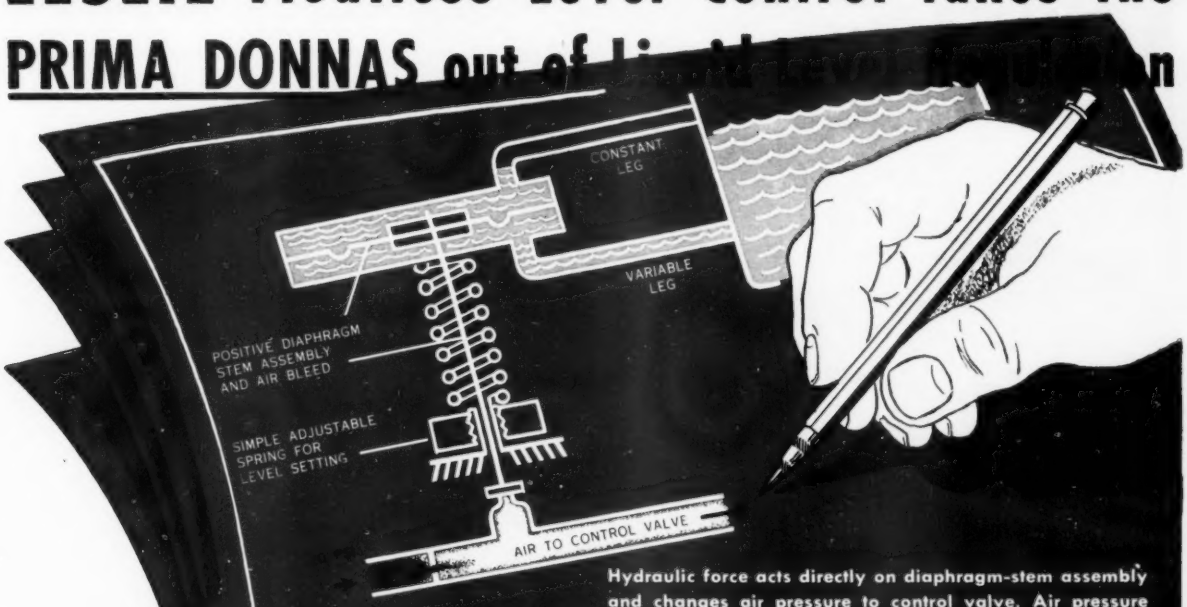
Continued from page 97

materially increases the settling characteristics and clarification of the water. This is especially advantageous where the solids content to the thickener is relatively low (in the range of 100 gr per gal) such as is found at this plant.

The thickening section consists of an extremely rugged circular collector, driven by a limited torque motor through sheaves to a primary speed reducer and then through a chain-drive to a 72-in. worm-driven main gear. This drive, designed to handle very large tonnages of solids, keeps the mechanism moving under the heaviest loads. If the collector should encounter a load beyond its capacity, such as a power failure or other stoppage permitting the solids to settle compactly, a hydraulic lifting device would raise the arms out of the mass. This same hydraulic system can be reversed for lowering the arms in increments to dig loose the packed material.

The thickened slurry (normally in the range of 50% solids) is moved to the center sludge hopper containing two slurry draw-off connections. Directly under the sludge hopper in the tunnel,

LESLIE *Floatless* Level Control takes the PRIMA DONNAS out of Li[illegible] Level [illegible]n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VARIABLE LEG
POSITIVE DIAPHRAGM STEM ASSEMBLY AND AIR BLEED
SIMPLE ADJUSTABLE SPRING FOR LEVEL SETTING
AIR TO CONTROL VALVE

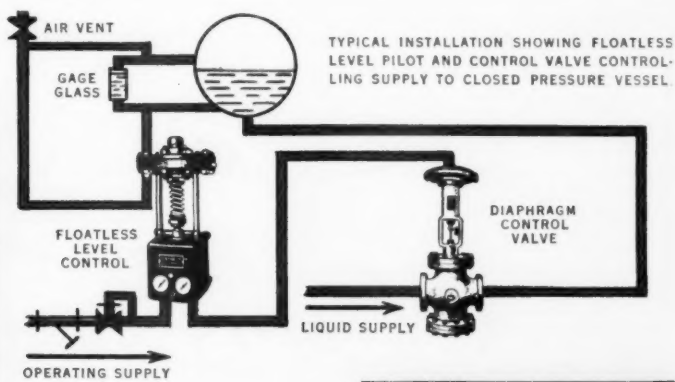
Hydraulic force acts directly on diaphragm-stem assembly and changes air pressure to control valve. Air pressure and valve travel are directly proportional to level change.

Here is level control that is not affected by surface agitation, equipment vibration, or the roll of a ship—a simple design that provides steady, positive, precise control even under extreme conditions.

Thousands are in service today, providing accurate control of liquid level (plus or minus 1″ water column) and eliminating the problems caused by troublesome linkages, torque tubes, floats and stuffing boxes.

Note these special features—

1. **Can be installed anywhere below liquid level . . . on control panel, if desired.**
2. **Simple, compact, one adjustment unit . . . weighs only 40 lbs.**
3. **Diaphragm stem assembly is only moving part. Diaphragm element doesn't require recalibration during service.**



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Here's *another* LESLIE *standard* item to fit specifications that are *special* orders with most manufacturers. When specifying pressure, temperature or level controls—for new or replacement service—it will pay to check *first* with your nearest LESLIE engineer. He's listed in the classified telephone directory in principal cities . . . under "Regulators" or "Valves"

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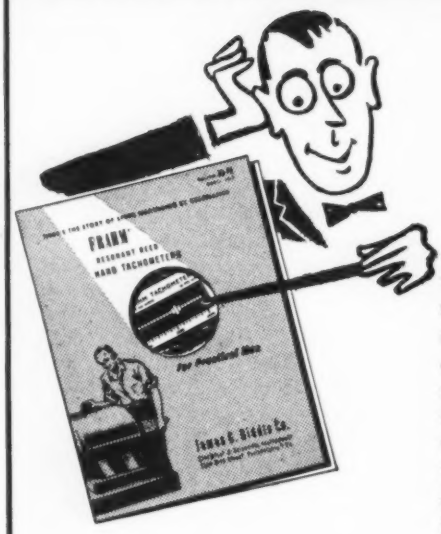

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. . . and this little booklet tells the story of resonant reeds. It's an interesting and practical presentation of the phenomenon of resonance as applied to the measurement of speed through the use of a set of tuned steel reeds mounted in a case with a scale calibrated in rpm.

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No contact with moving parts is required. Just touch the instrument to the chassis, frame or housing of the machine or motor and read the rpm directly.

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NAME

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COMPANY

ADDRESS

STEEL MILLS

Continued from page 218

enlarged to make a pump room, are two hydroseal pumps that take the thickened solids from the bottom of the thickener and pump them to a receiver tank in the sludge ejector building near the thickeners and above ground level. With the slurry pumps in this tunnel the sludge suction lines are made as short as possible. The filter house, though, is at considerable distance (around 1500 ft) from the thickener plant, and it was found expedient to use a booster system to maintain a 60-ft static head.

The booster system consists of a receiving tank, where the slurry pumps discharge two air-ejector tanks, necessary control valves, and air compressors. In operation, slurry, from the receiving tank, first feeds into one ejector tank until the tank is full. The flow then cuts off automatically and 100-psi air pressure is introduced into the tank to eject the sludge to a receiver tank in the filter building. At the same time, through a 3-way valve, slurry flow automatically diverts to the second receiver tank where the process is repeated. This gives extremely high-velocity flow at high pressure when passing through the slurry line, and eliminates any plugging-in tendencies in the long lines. During 1½ years of operation, these lines have never plugged under this procedure.

PIPE INSULATION

Continued from page 80

last two items are found from Fig. 2, as follows: To find insulation cost enter the bottom of Fig. 2 on the right at the price per running foot and project vertically to the annuity. At right, read insulation cost per running foot per hour. Heat-loss cost is found by entering at the bottom of the chart's left side at the insulation thickness, and projecting as indicated by the dotted line.

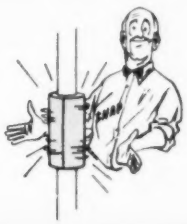
Note that temperature difference used for Fig. 2 is the result obtained by subtracting surrounding-air temperature from the hot-fluid temperature. For exact results, use the difference between pipe wall and insulation-surface temperatures. However, the first approximation is sufficiently accurate for almost every problem met in plant design.

Summing the C_h and C_i values in Fig. 4, firm *D* is found to offer the insulation that is most profitable. This is in contradiction to the conclusion that might be drawn from the curves in Fig. 4 where the product of firm *B* seems to have the lowest cost.

Rounding Off. The economical thickness found by the method described in this article may often appear to be quite

First ALL NEW Pipe insulation in 60 years

flexible glass fiber insulation . . .



resilient, snaps on . . .

insoluble in water . . .

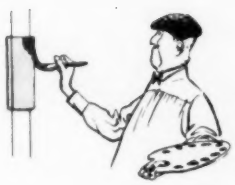
4 to 10 times lighter . . .

clean and pleasant to handle . . .

easy to cut with a knife . . .

won't break or crumble . . .

superior in thermal efficiency . . .



easy to finish . . .

G-B Ultrafine pipe insulation is a new one-piece molded pipe insulation of fine glass fibers. In every sense, it is the first all-new pipe insulation since the turn of the century—ideal for hot or cold lines, for plant maintenance or new construction.

To the many advantages you see illustrated here that make it far easier to ship, stock, and apply, you can add *economy*. For this new pipe insulation *costs no more* than other insulations—and actual applications reflect *savings up to 50%!*

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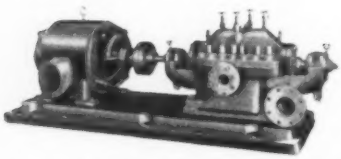

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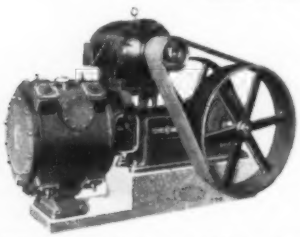

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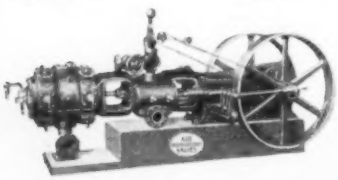

PENNSYLVANIA Class 4-AT Steam-driven Single-Stage, Horizontal, Water-Cooled, Roller Bearing Air Compressor.
Bulletin 185-I

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PIPE INSULATION

Continued from page 220

large, especially if the pipe is big and the price of heat is high. In such cases we may often ask ourselves: What is the permissible deviation from the theoretical thickness?

Studies show that for all normal cases the theoretical thickness can be rounded off downward to the nearest whole number. If weight or space considerations require a change of the most economical thickness, the effect on heat loss must be analyzed before a decision can be made.

Basis. These charts are based on the standard heat-transfer and economical relations for insulated pipes and circular tanks. We do not have sufficient space here to derive or present these relations, but they can be found in any of the standard volumes on heat transfer.

Symbols used in this article are: P_i = price of insulation, $ per ft; X = insulation thickness, in.; h_2 = heat-transfer coefficient, insulation to surrounding air, Btu per sq ft hr F; D_1 = diameter of inner surface of the insulation, in.; C_h = cost of heat loss, $ per ft hr; C_i = cost of insulation, $ per ft hr.

EDITOR'S NOTE: *Though the procedure suggested for finding* dP_1/dX *in this article is theoretically correct, experience shows that there may be appreciable variations in the values obtained because each operator picks a different slope at a given point. A more accurate procedure is to perform this step arithmetically, finding the slope at the desired points by setting up the proper ratios of* ΔP_i *to* ΔX.

WITH OUR READERS

Continued from page 5

of *Steam*. For verification you claim that the first issue of POWER was during 1884 and was labeled Volume IV. Volume X was issued during 1890, so 4 from 1884 and 10 from 1890 both take you back to 1880. As a well-known columnist would say, "Wanna bet?"

I concede that if a person was born during 1880, he would be 4 years old during 1884 and 10 years old in 1890. But a publication running yearly volumes and starting Volume I in 1880 would be printing Volume V during 1884. If POWER Volume IV was issued in November 1884, then it seems safe to assume that the first issue of *Steam* could not have started prior to 1881.

Actually though, *Steam* could have begun publication in October 1882, under Volume I, issued Volume II in 1883 and Volume III in 1884. When POWER took over as late as November 1884, it seems reasonable to expect that it would start a

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Manufacturers of A COMPLETE LINE OF BOILERS FOR EVERY HEATING AND POWER REQUIREMENT

When Byron Nelson stepped aside...

he revealed an interesting thing* about famous MacGregor irons

Byron Nelson, left, inspects finished golf club heads in the MacGregor Sports Products Inc. plant at Cincinnati, Ohio. He's near one of the machines that is used in making the irons. It's called a broaching machine and at the time the picture was taken it had finished more than 145,000 heads.

When Byron Nelson stepped aside he revealed a large drum of Pure Oil's Koolkut S-7—the superior cutting oil used at MacGregor in this broaching operation. Because the clubs are made of tough stainless steel forgings, the broach bar takes a terrific beating.

Interesting to everyone with metal-working problems

Pure Oil's KOOLKUT S-7 is a star-performer, too!

Metal-working operations that save the most time are often the toughest on tools—surface broaching, for example.

The right cutting oil is one of the most important factors; and they know that, at MacGregor. So they use Koolkut S-7 and stretch the life of all broach bars.

One of the great things about Koolkut S-7 is its *multi-purpose* quality—making it perform extremely well on light as well as heavy operations.

Pure Oil specializes in *high-quality multi-purpose lubricants*—oils and greases designed to do several different jobs equally well. *To help you reduce inventory, simplify procedure, and minimize waste and error.*

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Look them over! Check your needs! Every Western product for treatment of water, steam or fuel is proved in use, technically formulated for each individual problem.

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CORAVOL circulating throughout your steam system protects it from corrosive attack; cleans out rust deposits; increases heating and operating efficiency; reduces maintenance and labor costs. CORAVOL is the *original amine process* developed by Western Chemical Company.

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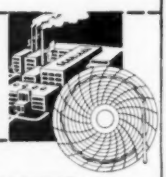
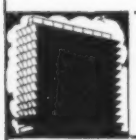
Special formulas for each individual boiler water and operating condition to eliminate scale, corrosion and foaming.





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Prevents scale deposit, corrosion, and algae growth in every type of cooling and condenser water system.

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Prevents corrosion and protects tanks and equipment in refrigerating brine and sweet water systems.

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Stops corrosion and scaling in hot water supply tanks and lines, maintaining service without impairing potability.

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Disintegrates and removes scale quickly from water jackets, cylinder heads, condensers, compressors, lines, coils, pumps.

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WITH OUR READERS

Continued from page 222

new volume, namely Volume IV, 1884, solving the "mystery" . . .

ART CANNON
Laurence Harbor, N. J.

Old friend Art Cannon is so right in his arithmetic and our faces are a dull brick red for starting him on it through error. Somehow, we cited the first issue of POWER *as being Volume IV—actually it was Volume V, which jibes exactly with his first set of suppositions regarding a start in 1880. At this writing, the situation is still confused but we're running down some leads on early volumes of Steam and may soon have a real answer to the apparent mystery. Here's hoping, anyway!*

Incidentally, Art asks how come the present volume of POWER *is No. 97, which on a yearly basis takes you back to about 1857. Since this may puzzle others, here's the dope: As old readers may remember,* POWER *was published weekly for many years. During that time, there were two volumes per year. Since 1932, when* POWER *returned to monthly issues, we have changed volumes annually. Thus the number of volumes doesn't match the number of years of* POWER*'s long life.*—ED.

PUMPS

Continued from page 117

opened, pressure is relieved, spring *S* swings the pistons eccentric with the central valve and cylinder block, for the pump to operate and maintain the pressure.

The pump, in Fig. 4 is not a variable-displacement unit in which the discharge can be preset to a given value, after which the pump will deliver that quantity at a pressure from zero to one that opens the relief valve. Instead, it delivers its rated quantity from zero pressure up to a value that throws the pump rotor into neutral for zero discharge. These pumps are built for pressures up to 2000 psi and 4.5 gpm, at speeds of 1000 to 4000 rpm.

Miss E'lise Harmon, an outstanding physicist and chemist long specializing in the printed-circuit, now heads printed-circuit activities of Aerovox Corp. This development has already attained the level of pilot runs in the laboratory and some radio-electronic manufacturers are now receiving actual production items.

Aerovox version of printed-circuit technique differs radically from conventional methods. Pure silver is bonded mechanically to a plastic support. Chemical etching is eliminated entirely. The result is a meticulous control of lines, razor-sharp edges and the meeting of critical mechanical and electrical specifications.

Another specific reason why it's Kellogg . . . when reheat is the order!

OCCASIONALLY there arises a unique situation which specifically demonstrates why Kellogg has been selected so frequently to fabricate and erect the power piping for high temperature reheat units during the current power expansion period.

This one occurred during the installation of the piping for the Albany station of the Niagara Mohawk Power Corporation. In connection with improving the economics of the overall system, which includes the reheat cycle, Niagara Mohawk engineers developed a considerably simplified piping arrangement between the high pressure extraction heaters . . . one which eliminated customary expansion loops.

However, although this design had economic advantages, it posed a problem: Because of the absence of expansion loops, how severely would thermal expansion during the high heat of welding and heat treatment strain the flanges and bolts on the heaters? Excessive stresses on these joints might well cause leaks in service.

Since it is virtually impossible to calculate these forces with any accuracy, Kellogg called upon its stress analysis group to devise a procedure for controlling them. This was accomplished by the use of electrical strain gages mounted on supporting rods and on the heater shell as shown in the photograph. (See arrows)

As a result of readings taken throughout the cycle, standards were established for the field assembly of this design which assure protection of the flanged joints of these heaters.

Special groups which specialize in stress analysis with its required knowledge of mechanics of materials—of plastic and elastic theory . . . continuous research and development towards further improvements in materials and in fabricating and erecting techniques . . . continuous accumulation of a tremendous store of experience in fabricating and installing piping for more than six million KW's of output—these are among the reasons why "Reheat Power Piping by Kellogg" is so often the specification . . . 40 times within the recent expansion period.

These leading companies are among the many major producers of power who use M. W. KELLOGG POWER PIPING . . .

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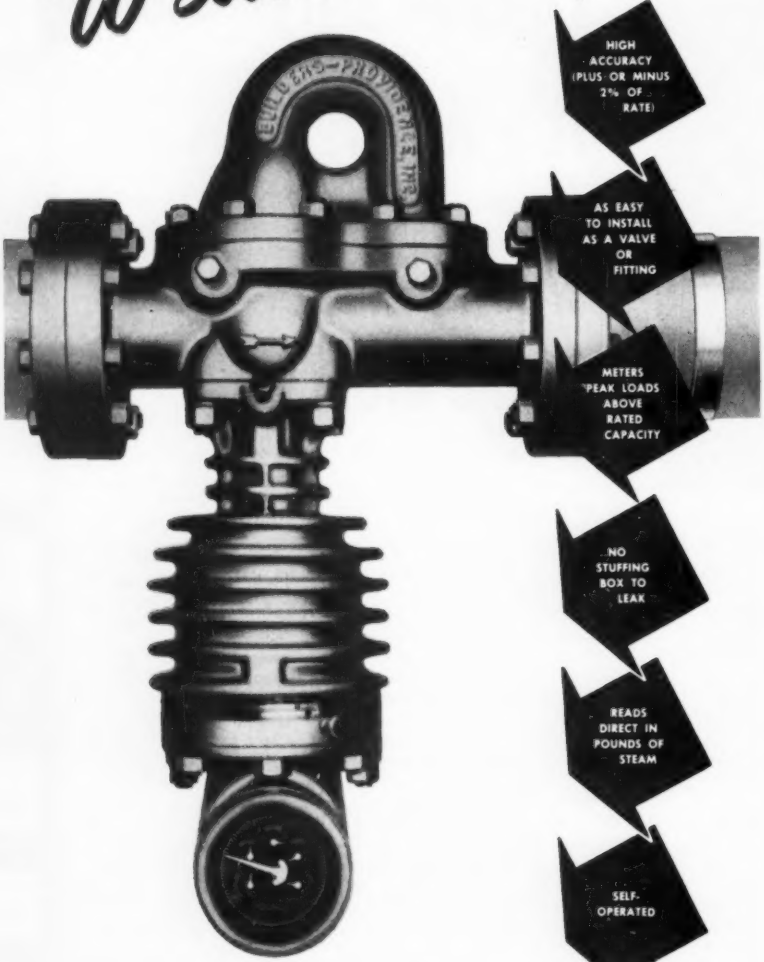
Meter Steam to save money!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METERS PEAK LOADS ABOVE RATED CAPACITY
NO STUFFING BOX TO LEAK
READS DIRECT IN POUNDS OF STEAM
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Install BUILDERS SHUNTFLO STEAM METER right in the steam line like a valve or fitting. Get accurate steam consumption figures in pounds on the direct-reading meter dial. Shuntflo Steam Meters available in two styles: Model SMKS (shown) for 2" to 14" lines — Model SMDH for 1" and 1½" lines. Write for Bulletins. Builders-Providence, Inc. (Division of B-I-F Industries), 354 Harris Avenue, Providence 1, Rhode Island.

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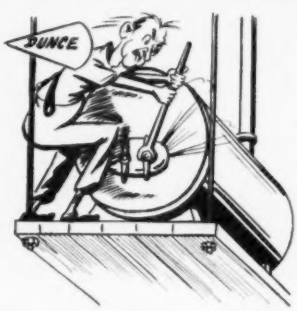

My Biggest Boner

► OUR LAUNDRY has a 3000-gal storage-type hot-water heater. Several months ago we took it off the line to clean scale from its interior surfaces. I shut off the water supply and opened the drain valve. Rather than go to the top of the tank to vent it, I opened an automatic water valve on one of the washing machines.

I figured air would enter the automatic valve and be drawn into the tank as the water left it.

When enough time had passed for the water to drain from the tank I climbed to a platform suspended ten feet above the floor, level with the tank's manhole. As I loosened the manhole bolts there was a sudden woosh of air being sucked into the tank. I tightened the bolts immediately, knowing that if I didn't, 3000 gallons of water would come flooding out at me.

My boner was in opening and not tagging a valve someone else could shut. The washman had seen the valve open shortly after I left the washroom, and he closed it. Some water drained from the tank, pulling a vacuum on it.

From now on I'll always tag a valve whose opening or closure could cause trouble in the plant.

F W MCCALL

Arlington, Mass.

● What is your "biggest boner"? We'll pay ten dollars for each one we publish.

Highest voltage switches ever built in this country, rated at 1600 amperes, are now being installed on the transmission lines supplying the AEC project near Portsmouth, Ohio. Delta-Star Electric Division of the H K Porter Co is supplying major portion of 330-kv switch units.

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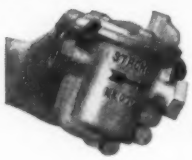

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- Oversized ports—increased capacity.
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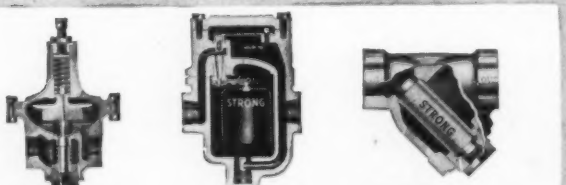

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BOOKSHELF

TRANE REFRIGERATION MANUAL. *(1953). 9x11, 125 pp, illust, cloth, $1.50. The Trane Co, LaCrosse, Wisconsin.*

Completely revised manual gives practical, easy-to-understand information on installation, operation and servicing of refrigeration equipment for contractors and servicemen. This latest edition contains two new chapters covering refrigeration piping and the latest engineering data on this subject. Other changes include a new chapter on refrigeration system control, a revised chapter on service operation and a revised refrigeration system service analysis chart.

Detailed information covers evaporators, compressors, condensers, thermostatic expansion valves, refrigeration system control equipment, motors and motor control equipment, heat exchangers, dryers, valves, piping and accessories. Text is illustrated with photographs, drawings, charts and graphs. Now in its ninth printing, this manual has been used extensively by colleges and industries as an educational text and source reference.

PIPE AND TUBE BENDING. *(1953). By Paul B Schubert, 6x9, 183 pp, illustrated, cloth, $5.00. The Industrial Press, 148 Lafayette St, New York 13, N. Y.*

Explains common methods of bending pipe and tubing, and the machines, fixtures, devices, etc. used. This book is meant to be a guide to help those interested in selecting method of bending best suited to their needs.

There is enough information to help the reader become well acquainted with operational details for any method, as well as problems or limitations posed. The practical, not the engineering approach is emphasized.

BIBLIOGRAPHY OF THE HEAT PUMP THROUGH 1951. *(1953). By 2701st Research and Development Unit, Battelle Memorial Institute for Signal Corps Engineering Laboratories. 8½x11, paper, 25 pp, $1, EEI Publication No. 53-4. Edison Electric Institute, 420 Lexington Ave, New York 17, N. Y.*

The 750 references on principles, design, operation and applications of the heat pump include articles, books, and miscellaneous publications both foreign and domestic. Publication dates of original material range from 1852 through 1951. Listings are divided into three sections: (1) signed articles identified by author (2) unsigned articles and handbooks identified by publication or publisher (3) books devoted exclusively to the heat pump.

STANDARDS FOR STEAM SURFACE CONDENSERS. *(1952). Third edition. 8½x11, paper, 17 pp, tables, illus. $2. Heat Exchange Institute, 122 E 42nd Street, New York 17, N. Y.*

The new book has been rewritten and revised and definitions have been clarified.

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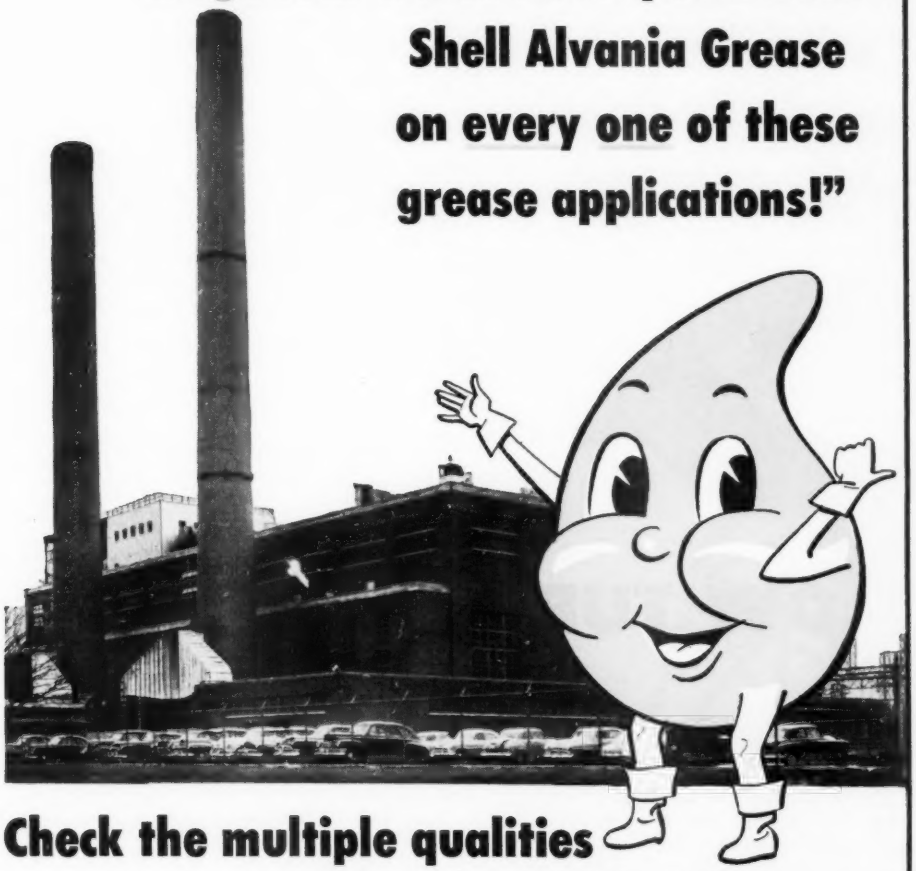

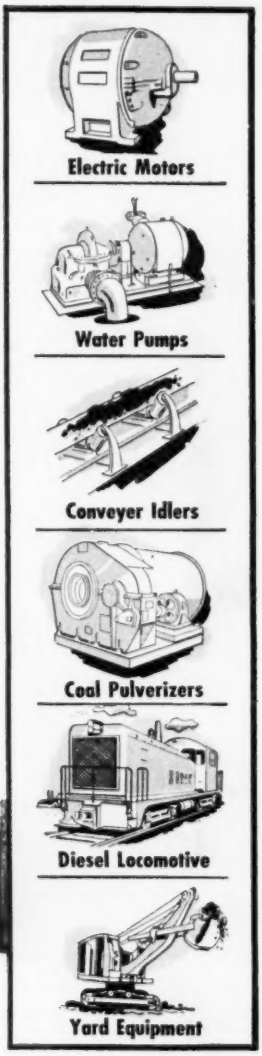

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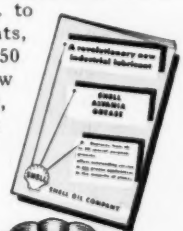

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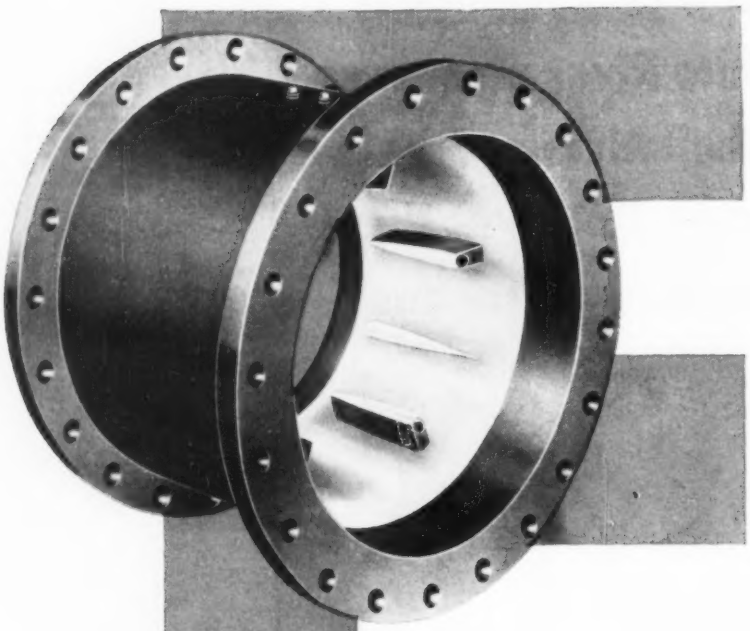

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More BOOKSHELF

Begins on page 228

New data based on tests conducted at Lehigh University help to arrive at values which represent maximum safe design limits. These include corrections in heat transfer for different tube materials. Performance curves have been included to show more nearly actual maximum performance. A new section of recommended sizes is included. The book covers recommended capacities for rapid evacuation and revised recommended vacuum pump capacities.

The Standards help purchaser of condensers by defining essential terms and setting up definite standards of heat-transfer rates and performance guarantees. They also contain material needed by engineers when writing specifications or designing surface condensing equipment.

BASIC MECHANICS OF FLUIDS. *(1953). By H Rouse, Professor of Fluid Mechanics and Director of Iowa Institute of Hydraulic Research, and J W Howe, Professor and Head of the Department of Mechanics and Hydraulics, State University of Iowa. 6x9¼, cloth, 245 pp, 145 illus, 8 tables. $4.50. John Wiley & Sons, Inc, 440 Fourth Ave, New York 16, N. Y.*

This book applies the basic principles of kinematics and dynamics to the elementary motion of a fluid to study the effect on each essential property of the fluid. A constant effort is made to realize the use of general methods of analysis rather than isolated procedures for solving particular problems.

To simplify presentation and analysis, the authors have avoided using the partial derivative in the mathematical treatment of the subject. Omission of the more complex aspects of the subject, such as inherently unsteady flow, and restriction of problems to direct application of individual principles has resulted in further simplification. The topics covered include fluid statics, fluid kinematics, fluid dynamics, effects of fluid weight, fluid viscosity, turbulent flow in conduits, flow past immersed bodies, lift and propulsion and fluid compressibility.

POWER PLANT ENGINEERING. *Third edition. (1593). -By F T Morse, Professor of Mechanical Engineering. University of Virginia. 6x9¼, cloth, 687 pp, illust, tables, charts, $8.75. D Van Nostrand and Company, Inc, 250 Fourth Ave, New York 3, N. Y.*

This well-known text book has been completely rewritten and its title shortened by dropping out the words "and Design." The former chapters on hydraulic power and electrical equipment have been dropped. The space thus released has been used for greater coverage of steam-plant equipment and information on gas-turbine plants and nuclear energy.

As in the earlier editions, the book strives to present a thorough study of stationary power and heating plants, including public service, industrial and institutional types. Fundamentals are emphasized as well as the integration of the plant as a whole rather than concentration on design deatils. Much

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More BOOKSHELF

Begins on page 228

greater emphasis has been placed on the small plant than in the former editions. The author has given more space to the review of applied thermodynamics than formerly.

Topics covered in this edition include, analysis of variable loads, plant economics, plant buildings, fuels, combustion, internal-combustion engine plants, gas-turbine plants, vapor cycles, steam generators, steam engines, steam turbines, condensers, plant auxiliaries, piping and instrumentation.

MEASUREMENT TECHNIQUES IN MECHANICAL ENGINEERING. *(1953). By R J Sweeney, consulting engineer, 6x9¼, cloth, 309 pp, illus, $5.50. John Wiley & Sons, Inc, 440 Fourth Ave, New York 16, N. Y.*

This book describes measuring methods used in performance testing of power equipment. These methods include mechanical, electrical and chemical principles of operation. Instruments are covered with respect to their functions as measuring and indicating devices and as signalling devices for automatic controllers.

The author directs his material toward (1) engineering students and (2) practising engineers. His aims are to describe the principles of the instruments and to instil an understanding of the pitfalls to be avoided and the difficulties involved in obtaining a correct measurement of physical quantities. Comparative methods of calibration with primary standards are described for most instruments. The author examines errors arising from installation layout and supplies a method for roughly estimating the magnitude of such errors.

Chapter topics include: mensuration, mass, time and speed, electrical measurements, dynamometers, pressure, temperature, fluid flow, calorimetry, chemical analysis and automatic controls.

TEXTBOOK OF THE MATERIALS OF ENGINEERING. *Eighth edition. (1953). By H F Moore, Research Professor-emeritus of Engineering Materials, Engineering Experiment Station, University of Illinois, and M B Moore, Associate Professor of Mechanical Engineering, Rutgers University. 6x9¼, cloth, 372 pp, 140 illust, tables. $6. McGraw-Hill Book Co, 330 West 42nd Street, New York 36, N. Y.*

An introduction to the properties of various materials used for machine and structural parts is presented in this newest edition of a well-known book. These properties include the strength, stiffness, ductility, and resistance to corrosion or wear of a wide variety of materials. The discussion covers the control of these properties in production by casting, molding, and forging and the chemical and mechanical methods of strengthening them by heat treating, alloying, hammering, rolling and aging.

The internal structures and also the producing processes of various materials are described briefly. The new edition includes recent information developed by the electron microscope, a short discussion of resistance to fatigue by metals under compressive loads, discussions of Boron and

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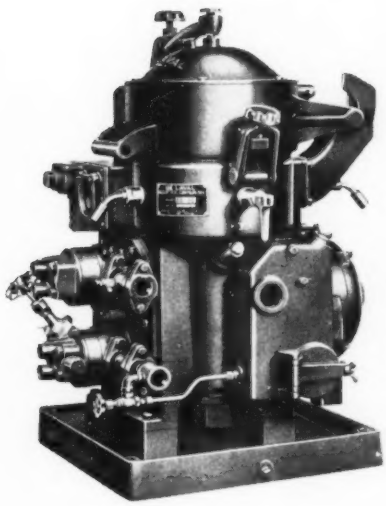
YOU CAN'T SIDESTEP TROUBLE BUT YOU CAN PREVENT IT!

"Avoiding" trouble by hoping it won't happen to you can be costly. Better to ***prevent*** serious shutdowns by ***protecting*** your power unit from both of the causes of oil contamination—dirt and water. The comparatively modest investment represented by the cost of a De Laval centrifuge is far outweighed by the cost of even one serious shutdown.



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De Laval Oil Purifiers do not remove oil-soluble additives — action within the centrifuge is entirely mechanical.

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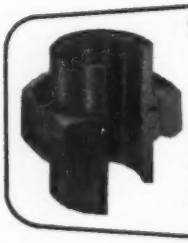

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More BOOKSHELF

Begins on page 228

Titanium, pre-stressed and air-entrained concrete and a new treatment of numerous plastics. The book uses the nomenclature for fatigue of metals recommended by the ASTM.

GAS TURBINE ANALYSIS AND PRACTICE. *(1953). By B H Jennings, Professor and Chairman, Department of Mechanical Engineering, and W L Rogers, Assistant Professor of Mechanical Engineering, The Technological Institute, Northwestern University. 6x9¼, cloth, 487 pp, illust, tables. $8.50. McGraw-Hill Book Co, Inc, 330 West 42nd Street, New York 36, N. Y.*

The authors address this book to those who have some knowledge of basic thermodynamics and mechanics. Each component of the gas turbine is analyzed from both energy and stress standpoints. A table of air properties included as an integral part of the book simplifies the solution of problems. Various turbine and compressor design types are discussed and analyzed. Brief reviews are given of applications for aircraft, marine, locomotive, power generation and industrial purposes.

Close attention is given fuels, combustion and combustion chambers for gas turbine plants. A chapter on vibration and balancing and another on stresses in plant elements demonstrate practical design problems that must be solved. The book closes with a chapter on materials and metallurgy for the gas turbine.

GASDYNAMIK (GAS DYNAMICS). *(1952). By Dr K Ostatisch. 7x9¾, cloth, 456 pp. 300 illus, tables, calculating charts. $18.60. Springer-Verlag, Molkerbastei 5, Wien 1, Austria.*

An advanced text in fluid dynamics dealing with the thermodynamics and kinematics of fluid flow. This book employs partial differentials and multiple integrals in discussing the subject. Treatment appears wholly theoretical with little design data provided. Includes information on testing methods used in research investigations. Written wholly in German.

OPPORTUNITIES IN ELECTRICAL ENGINEERING. *(1953). By S P Shackleton, Bell Telephone Laboratories. 8x5½, paper, 128 pp. $1. Vocational Guidance Manuals, Inc, 45 W 45th Street, New York 36, N. Y.*

A well-written book directed to young people who contemplate entering the electrical engineering profession. The author explores all aspects of the profession which a youngster should consider before embarking upon an engineering educational course of study. He describes the engineering profession generally and then gives detailed explanations of the electrical specialties.

Subjects covered include: education, licensing, getting started, advancement, opportunities for employment, related fields and organizaiton of the field. Any engineer who wishes to counsel high school students on the nature of electrical engineering should have a copy of this book in his

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■ Since 1940, the Indianapolis Power and Light Company has put NONPAREIL Turbine Oil into one new turbine after another. Today, this rapidly growing company has eight big turbines—with 363,000 KW capability—operating on this unique lubricant.

During the 13 years it has been in use, NONPAREIL has provided convincing evidence of its ability to eliminate oil replacements and oil-system cleaning. None of the original fills of NONPAREIL have needed to be replaced. Neutralization numbers have stayed below 0.07 mg. KOH/gm. Oil systems have remained entirely clear.

The lubricant and maintenance savings realized by this utility are just the beginning. Trouble-free lubrication and consequent savings are *assured for the life of the eight turbines* in normal operation. This is based on the written guarantee, given with each fill of NONPAREIL, that this outstanding lubricant will last as long as the turbine, and that its neutralization number will stay below 0.15 mg. KOH/gm.

The Standard Oil lubrication specialist serving your section of the Midwest will be glad to show you lubrication records of NONPAREIL in installations similar to your own. These records cover up to 25 years' continuous operation of individual units on original fills of oil. You can contact this specialist by phoning your local Standard Oil Company, 910 South Michigan Ave., Chicago 80, Illinois.

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To Overcome Their Icing Troubles

End view of tower at top, showing air intake on either side.

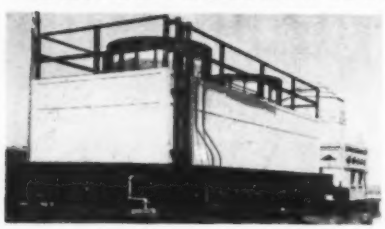
Excessive winter icing conditions from an existing tower of another make led to the design and installation of this United Cooling Tower.

Built for an Iowa public utility, it features a heated air intake, utilizing hot water distributed through spray nozzles into the incoming air.

Result:—more moisture absorption, minimum drift, water loss and freezing.

This is an example of how United designs towers . . . without rigid standardization . . . to solve your individual water cooling problems. *Write us for details.*

United Towers for Air Conditioning



A good cooling tower is the best protection for a good air conditioning system. The United tower on the left, a 1600 G.P.M. low head tower with sprinkler distribution, serves the air conditioning system of a southwestern railroad station. United also builds redwood filled, mechanical draft steel towers, 3 to 15 tons, and package type redwood spray towers, 3 to 30 tons.

UNITED COOLING TOWER COMPANY

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UNITED COOLING TOWERS

More TECHNICAL BRIEFS

Begins on page 150

method of calibration involved a considerable number of individual temperature deflections in an electro-optical system for a given crank angle. The average temperature deflection then was plotted against the temperature as found by the so-called sodium "D" line reversal method. The following conclusions were advanced:

(1) Individual temperature - crank angle cycles may be photographed. This makes it possible to study temperature variation from cycle to cycle, and to determine maximum and minimum peak cycle temperatures.

(2) As evidenced by performance on different fuels, the results were free of the effects of chemi-luminescence.

(3) Because the method reports individual cycles, average cylinder temperatures must be determined from a great number of randomly selected cycles.

(4) As this is not a primary method, the calibration must be undertaken with great care. Allowance must be made for variation of emissivity, for the geometry of the optical system, and for the concentration of the alkaline salt. *ASME Paper No. 53-S-46.*

Directions for ordering papers on p 152

Economic and Design Considerations for Large Power Plant Stacks. *By H L von Hohenleiten and R H Kent, Consolidated Gas Electric Light and Power Co.*

With the range of fuels, the amount of excess air, allowance for air leakage, estimates of gas temperature and the maximum cfm of flue gas per boiler determined, we start out by making an estimate of the approximate stack dimensions.

Until recently, the stack diameter was chosen to give a minimum practical friction loss. In many cases this resulted in a stack velocity of the order of 50 fps. With the necessity for higher and higher stacks in order to achieve proper dispersion of the combustion products, the designer will find that friction loss is no longer the proper criterion for selection of the optimum diameter. To get reasonable relations between stack diameter and height for structural considerations, he will have to choose a much larger diameter which, in turn, will reduce materially the flue gas velocity through the stack barrel. To provide the necessary emission velocity, nozzles may be introduced at top of stack.

NEWS ABOUT "TEFLON"

How valve components of Du Pont "Teflon"* are giving improved performance at less cost

Du Pont "Teflon" tetrafluoroethylene resin has found increasing use as a material for valve components—gaskets, packings, seats and discs, plug valve parts and diaphragms. It provides a unique combination of properties of particular interest to manufacturers and users of valves.

- **CHEMICAL INERTNESS.** "Teflon" is completely unaffected by acids, alkalis, aliphatics, aromatics, chlorinated hydrocarbons . . . *all* chemicals except molten alkali metals and fluorine at elevated temperatures.
- **HEAT RESISTANCE.** Gives continuous service up to 500°F.
- **LOW-TEMPERATURE TOUGHNESS.** Has been used as low as –460°F.
- **LOW COEFFICIENT OF FRICTION.** Lets the valve operate easily. Requires no lubrication.
- **EROSION RESISTANCE.** Resists erosion by impinging fluids.

Valves with components of Du Pont "Teflon" are especially useful to manufacturers of: chemicals, fertilizers, petroleum, soap, chlorine, foods, plastics, sugar, dyes, insecticides, rubber, textiles, explosives, paper, pharmaceuticals, photographic film.

The Polychemicals Department of the Du Pont Company supplies "Teflon" in the forms of molding powders and aqueous dispersions. These forms are converted into various valve components and molded articles by a number of manufacturers for use in chemical and allied equipment. For further information, write: E. I. du Pont de Nemours & Co. (Inc.), Polychemicals Department, Room 2611, Du Pont Bldg., Wilmington 98, Delaware.

*REG. U.S. PAT. OFF.

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...THROUGH CHEMISTRY
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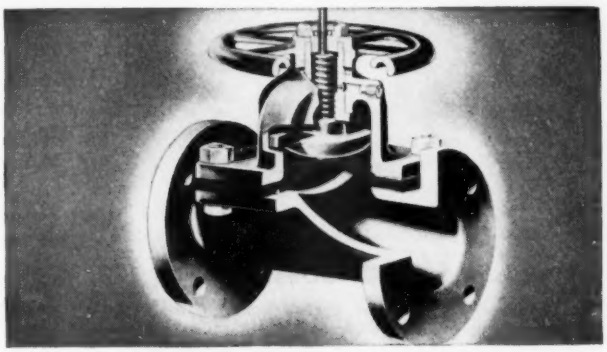
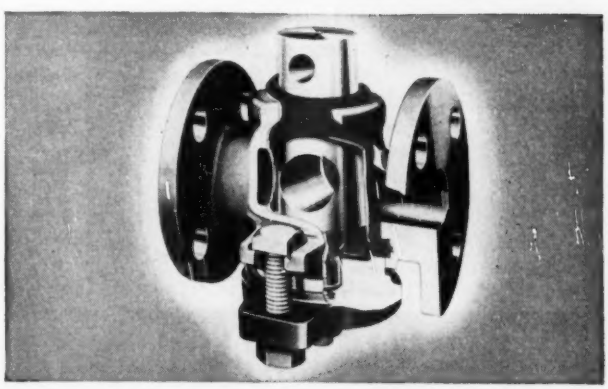


VALVE DIAPHRAGMS demonstrate the chemical inertness and thermal stability of Du Pont "Teflon." This diaphragm of pure "Teflon," above, was designed for continuous operating pressures of 100 psi and temperatures of 400°F. The valve is made by Hills-McCanna Co., Chicago.

GASKETS AND PACKINGS of "Teflon" often outlast the valve itself. Available in many forms for varied valve uses. Du Pont "Teflon" resists corrosive attack, insures a tight seal. Pictured is a chemical porcelain valve made by the Lapp Insulator Co., Inc., LeRoy, N. Y.



PLUG VALVE COMPONENTS (sleeves and cock washers) utilize the low coefficient of friction and non-adhesive characteristics of "Teflon." They prevent sticking or freezing in the valve body, often simplify design, give excellent results. The valve above is made by The Duriron Co., Inc., Dayton, O.

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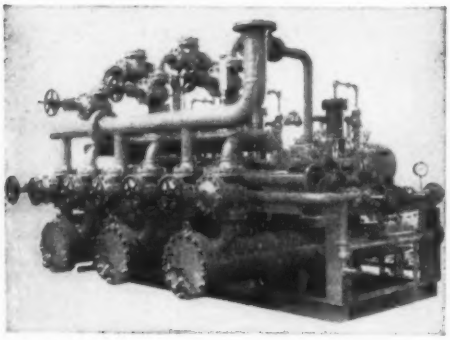

The compact, high-pressure Unit shown consists of one Turbine-driven and two Motor-driven Pumps, and three Shell-and-tube-type Oil Heaters mounted on a single frame. This Unit is designed to handle a capacity of 50,000 pounds per hour of bunker fuel oil against 400 P.S.I.

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More TECHNICAL BRIEFS

Begins on page 150

Three types of stack construction are considered by the authors. First, self-supporting steel stacks with gunite lining; second, reinforced concrete stacks with independent brick lining; third, brick stacks with independent brick lining. Costs for the first type usually will have to be worked out by the designer, while costs for concrete and brick stacks will have to be obtained from stack construction companies. In order to get a sufficient number of points for plotting, it will be advisable to design stacks for the preliminary height as well as for stacks 50 or more ft higher and, possibly, 50 ft lower. To get an economic analysis, foundations for all of these cases will have to be worked out and then the results plotted in the form of curves. Beside the initial cost, possible maintenance costs must be considered.

The choice of outlet velocity has to be influenced to a large degree by economic considerations. On the basis of accepting 60 fps as an absolute minimum, incremental costs for various outlet velocities and two or three different stack heights should be computed. Taking capitalized Energy Cost, Capacity Charge, Cost of Fan, and Cost of Motor into consideration, we see that the higher outlet velocities form a sizable investment. *APCA Paper, no number.*

Directions for ordering papers on p 152

Some Problems Encountered in Sampling Open Hearth Stacks. *By J H Smith, G L Rounds and H J Matoi, Kaiser Steel Corp.*

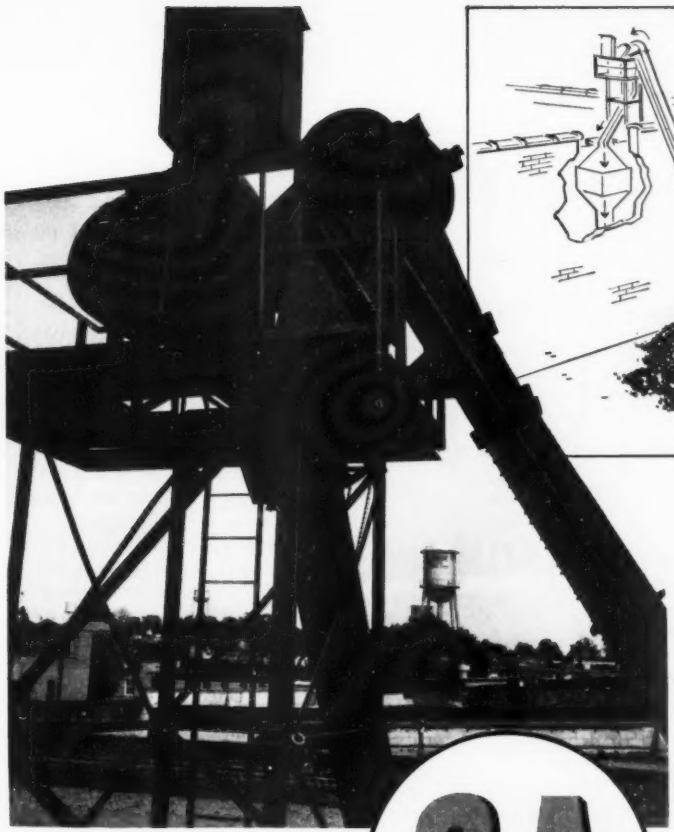
A number of problems encountered in open hearth sampling are caused by conditions inherent in basic open hearth furnace operations. A summary of some of these conditions is presented and a description of a typical sampling procedure, pointing out the specific problems introduced by these conditions, is given.

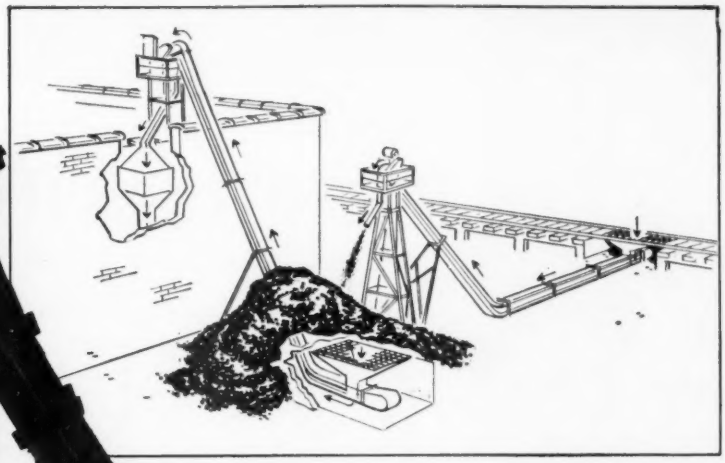
Stack conditions are as follows:

(1) The moisture content of the open hearth stack gases is about 7-8% by volume with a dew point in the neighborhood of 100 F. This necessitates heating portions of the sampling train to prevent undesired condensation in the equipment.

(2) Temperatures, in the stack at the sampling point, are approximately 1100 F without a waste heat boiler, and approximately 500 F with a waste heat boiler. This necessitates selection of equipment to withstand thermal failure.

(3) The presence of an oxidizing





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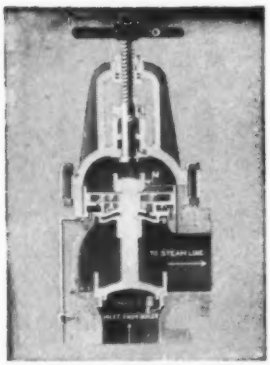

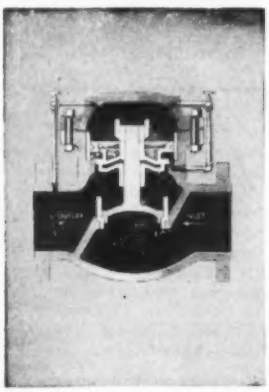

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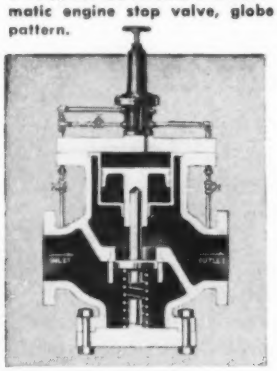

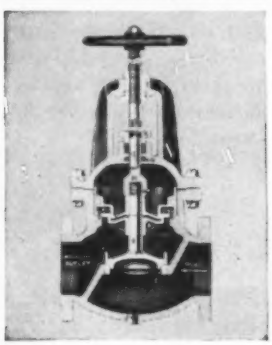

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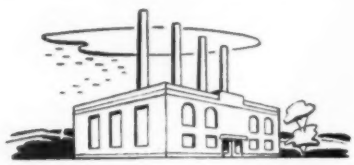

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More TECHNICAL BRIEFS

Begins on page 150

atmosphere at elevated temperatures introduces the problem of corrosion. Erroneous sampling data result unless the equipment is constructed of material which will withstand corrosion.

(4) The particulate loading of the gases varies throughout the heat; a factor which must be taken into consideration when taking a sample. The loading varies from 0.5 to 2.5 grains per standard cubic foot with a maximum loading occurring during the ore boil. Particle size ranges normally from less than 0.5 to 3 microns with material from 2 to 3 millimeters being discharged during the flue blowing period. The major constituent is iron. No analysis is presented here as the constituents are generally common to all basic open hearths. Particulate build-up on sampling equipment due to impaction often results in fouling of equipment.

Sampling procedures recommended were to sample at a location ten diameters away from the nearest obstruction. This permits sampling from an undisturbed gas flow pattern in the stack. Since the stack inside diameter decreases with height, the average inside diameter is used to choose the sampling location.

At the ten stack diameter level, where the flow is still quite turbulent, use graphic integration to get an average velocity.

Directions for ordering papers on p 152

Further, it is desirable to ascertain the average velocity of the stack gases before actual sampling. These data assist in choosing the proper size sampling nozzle, the sample size and the position to place the sampling nozzle across the diameter of the stack. There are several devices on the market for determining the velocity of gas streams. A vane type anemometer cannot be used because of the high temperature and particulate loading. The separate impact tube and static tap device is unwieldly and does not provide desired results. The pitot tube appears to be best suited for open hearth work.

The equipment required for measuring the pressure head of the pitot tube should have a range of 0.00 to 0.25 inch of water. A convenient device for this is an inclined draft gage.

For velocity calculations, you need to know the stack gas density; therefore, the composition of the gas must be

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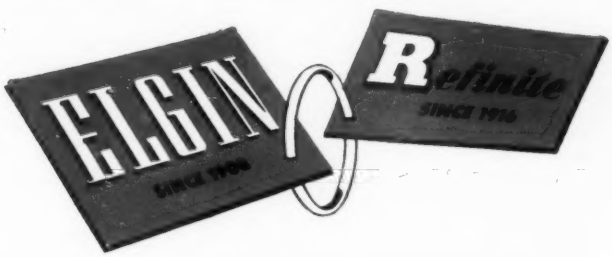

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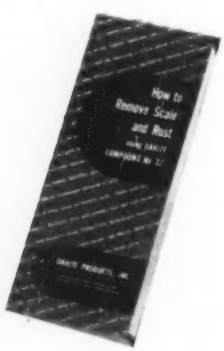

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Begins on page 150

known as well as its temperature and pressure. The temperature is obtained by a combination pitot tube-thermocouple. Stack pressure can be obtained with a simple U-tube manometer or an inclined draft gage with a range of 0.0 to 1.5 inches of water. The gas analysis for CO, CO_2, and O_2, can be obtained with sufficient accuracy by the Orsat method. A more complete and accurate gas analysis is considered spurious because of the small difference that would be affected in the calculated density.

The wet-dry bulb method proved quite satisfactory to determine the percent of water in the stack gas. The assumption was made that the psychrometric charts for air and water applied to stack gases. This assumption held true within the required accuracy for further calculations. It is interesting to note that the stack gas density is practically identical with air. *APCA Paper, no number.*

Directions for ordering papers on p 152

Mixing and Equilibrium in Pipe Flow. *By W H Carrier and W S Misener, Carrier Corp.*

A semi-classical approach to the problem of mixing or redistribution in pipe flow is developed and checked against a series of tests when a jet discharges into the open end of a pipe. The theory presented successfully describes the changes in velocity distribution as a jet-like peaked flow that decays and, under proper conditions, offers a moderately good prediction of the change in total pressure. There is some indication that the theory can be extended to cover normal pipe flows.

The test data are of considerable independent value and tabulated in detail with typical cases plotted to illustrate the various phenomena measured. The momentum loss area of two typical cases is plotted vs. L/D, illustrating the way momentum loss reduces exponentially, over-shoots its final value somewhat, then rises to assume the value corresponding to the Reynold number.

Perhaps the most important single item arising from the present theory and tests is the concept of the decay coefficient and the fact that it is almost independent of Reynolds number. This would seem to indicate that the turbulent mechanism itself is not greatly affected by Reynolds number.

It is hoped that the success of the simple semi-classical approach used here in predicting the performance of a symmetrical mixing flow in a pipe will provoke some productive thought and eventually will result in some gains in

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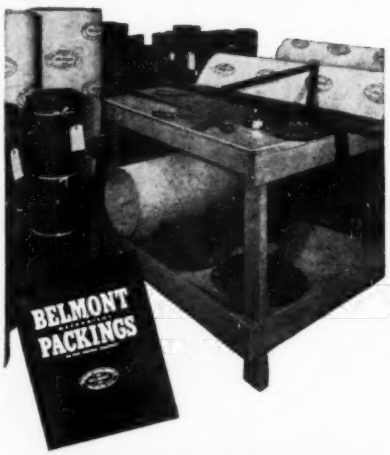

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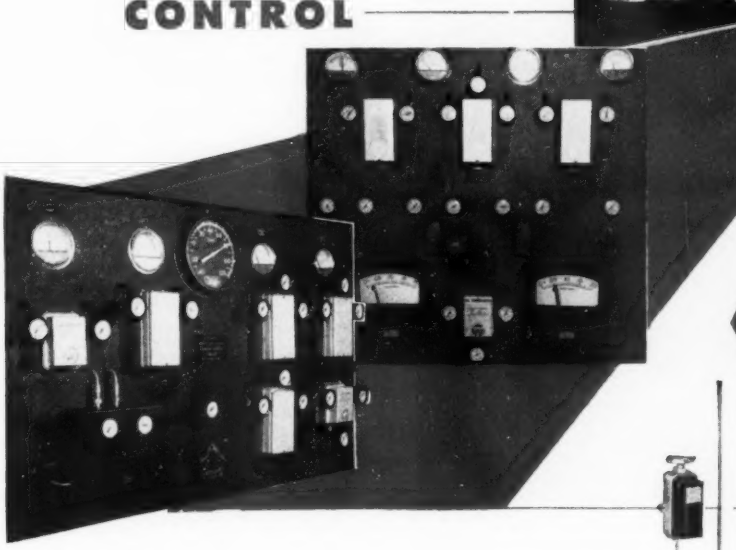

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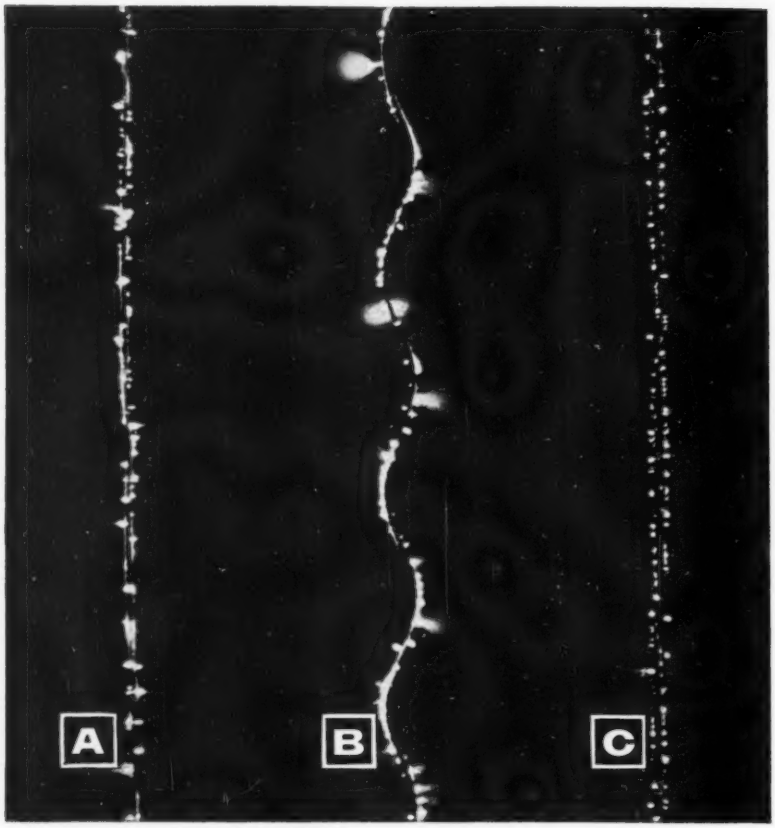

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Begins on page 150

our understanding of turbulent flow. It is hoped also that the data and simple theory will find some use among engineers for predicting pressure changes due to redistribution, the length of path required to reach an equilibrium condition, and interim velocity profiles. *ASME Paper No. 53—S-44.*

More FREE BULLETINS

Begins on page 163

15 **Microwave radio**—equipment and its application in electric utility industry explained in 2-color, 8-page booklet. Photos and application sketches. Booklet B-5850, Westinghouse Electric Corp, Pittsburgh 30, Pa.

16 **Gearmotors**—with single, double and triple speed reduction shown in 2-color, 4-page leaflet. Photos and cutaways. Bulletin PB 18000-1, Elliott Co, Crocker-Wheeler Div, Ampere, N. J.

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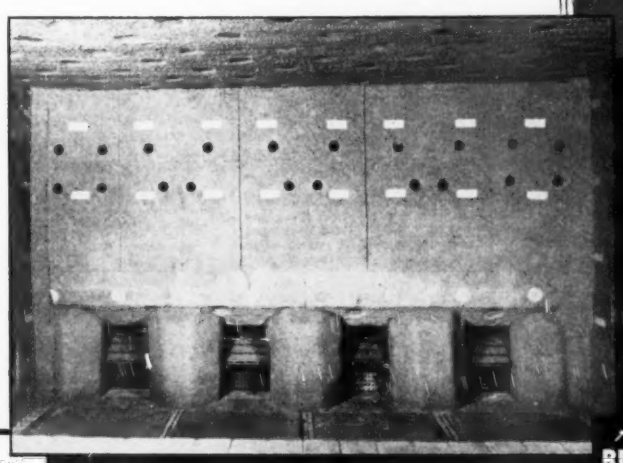

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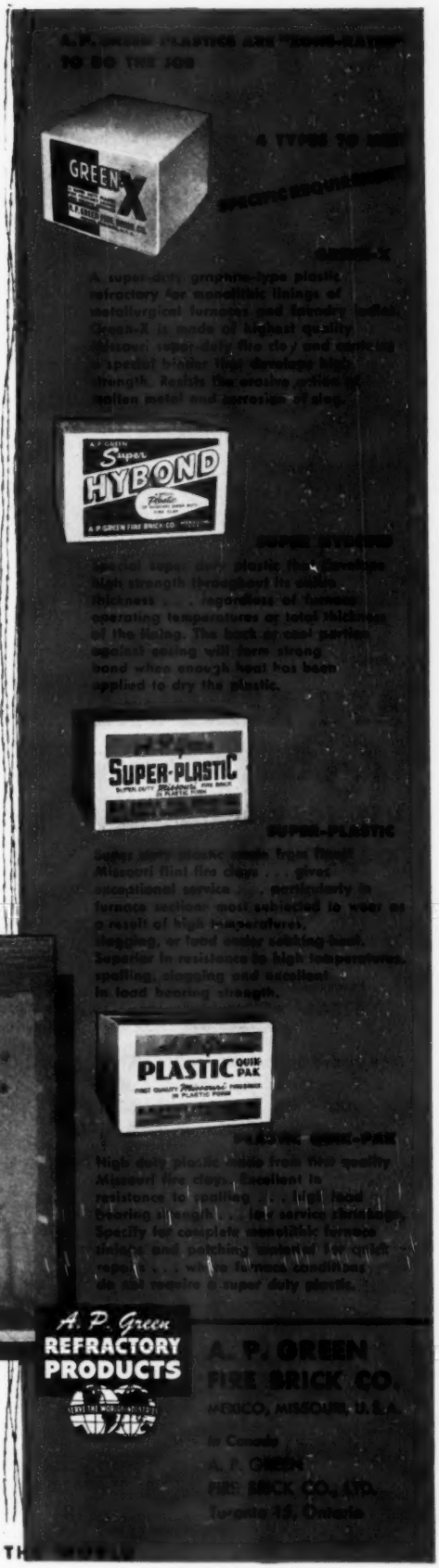

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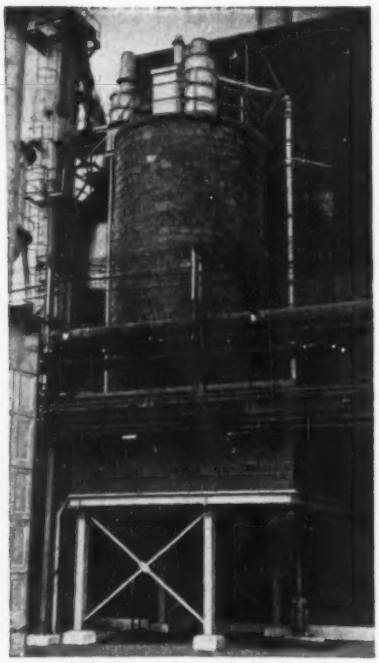

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Are ash removal costs a factor in cutting your profits? We suggest a survey by a National engineer. It will cost you nothing. It may avoid wasted dollars.

NATIONAL PNEUMATIC STEAM ASH REMOVAL SYSTEMS

save money in two ways—

1. Exceptionally easy one-man operation cuts labor cost to the bone.
2. Maintenance costs are surprisingly *low* because rugged NATIONAL construction results in maximum life for parts.

A complete and effective service policy and a reputation for delivering satisfaction are extras that go with NATIONAL installations.

NATIONAL CONVEYORS COMPANY, INC.
50 CHURCH ST., NEW YORK 7, N.Y.
Manufacturers of The National ChipVeyor System For Metal Turnings—Furnace Doors—Feeders—Ash Gates and Related Equipment.

More FREE BULLETINS

Begins on page 163

and accessory information. Bulletin GEA-6020, General Electric Co, Schenectady 5, N. Y.

28 **Centralized instrumentation**—and the equipment required featured in 32-page, 2-color booklet. Photos and full description of various items. Bulletin 85-20, Minneapolis-Honeywell Regulator Co, Wayne & Windrim Ave, Philadelphia 44, Pa.

29 **Gas analysis**—apparatus covered in 48-page catalog. Photos and descriptions for various equipment items and accessories, Catalog 81, Burrell Corp, 2223 Fifth Ave, Pittsburgh, Pa.

PIPING, VALVES, FITTINGS, ETC

30 **Steam trap service**—guide covers testing and preventive maintenance, inspection and repair trouble shooting in 8-page, illustrated booklet. Bulletin 239, Armstrong Machine Works, Three Rivers, Mich.

31 **Gate valves**—all-iron and iron body-bronze mounted, shown in 4-page, 2-color circular. Photos, cutaways, full specs, Circular 561, Lunkenheimer Co, Cincinnati 14, Ohio

32 **Combination** — air-release-inlet valve explained in 4-page bulletin. Cutaways, sectional drawings, full specs. Bulletin 1203, Simplex Valve & Meter Co, 68th & Upland St, Philadelphia 42, Pa.

33 **Blow-off valves** — and proper methods of preventive maintenance covered in 6-page, 2-color folder. Yarnall-Waring Co, Mermaid Lane, Philadelphia 18, Pa.

PRIME MOVERS & ACCESSORIES

34 **Diesel electric sets**—and their applications featured in 8-page, illustrated booklet. Form 30658, Caterpillar Tractor Co, Peoria, Ill.

35 **Gas, diesel** — and combination engines, atmospheric and supercharged and with ratings from 690 to 2500 hp, featured in 10-page booklet. Photos, cutaways, dimensional drawings and full specs. Bulletin L-71, Cooper-Bessemer Corp, Mt Vernon, Ohio

36 **Oil and dual-fuel** — diesels and high compression spark ignition engines discussed in fully illustrated bulletin series. Bulletins S-500-B55, S-500-B54, RP-492, RP-481, Worthington Corp, Buffalo 5, N. Y.

37 **Catalytic exhaust**—a device for removing carbon monoxide fumes and odors from all types of gasoline-powered equipment, described in 4-page, illustrated folder. Oxy-Catalyst, Inc, Wayne, Pa.

PUMPS

38 **Multi-stage** — centrifugal pumps featured in 18-page, 3-color booklet. Photos, cutaways, dimensional drawings, performance data and full specs. Form 7251, Ingersoll-Rand Co, 11 Broadway, New York 4, N. Y.

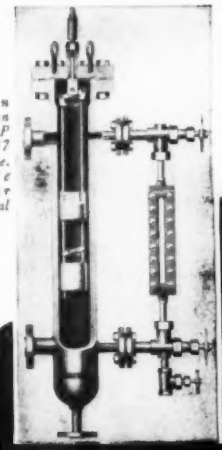
39 **Small industrial pumps** and general purpose pumps covered in two 3-color, 12-page catalogs. Service and operating data, special features, dimensions and parts diagrams, performance curves and mounting styles and modifications included. Catalogs 101, 102, Tuthill Pump Co, 939 E 95th St, Chicago 19, Ill.

40 **All-purpose pump**, model 109, described in 3-color brochure. Details of pump and switch operation shown with sectional drawings and specs. Circular 12, Kenco Inc, 1125 N Ridge Rd, Lorain, Ohio.

41 **Standard end suction** centrifugal pumps discussed in 4-page bulletin. Photos, performance curves, specs incl. Bulletin W-300-B4, Worthington Corp, Harrison, N. J.

WATER TREATMENT

42 **Industrial filtration** equipment discussed in 8-page, illustrated bro-



Jerguson Water Column with 7-HP Gage and A-37 Drain Valve. Available complete, or as individual units.

JERGUSON WATER COLUMNS Give Positive Alarm Signals

Keen Knife-Edge Balance Holds Key To Outstanding Jerguson Performance

YOU'RE sure of positive boiler alarms with JERGUSON WATER COLUMNS . . . because keen *knife-edge balance* assures immediate action.

Positive action is necessary when boiler water level falls too low or rises too high in your boiler. Jerguson's camshaft arrangement exerts sufficient force to give the power to assure action under all conditions. The warning whistle blows *immediately* when the limit is reached in either direction.

The alarm mechanism on JERGUSON WATER COLUMNS is stainless steel throughout. Valve stem, cam, and knife edges are carefully hardened. A complete range of pressures and sizes, with screwed, flanged, or welding connections. There's a dependable JERGUSON WATER COLUMN to fit your requirements. ***Write for Data Unit***

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Gages and Valves for the Observation of Liquids and Levels
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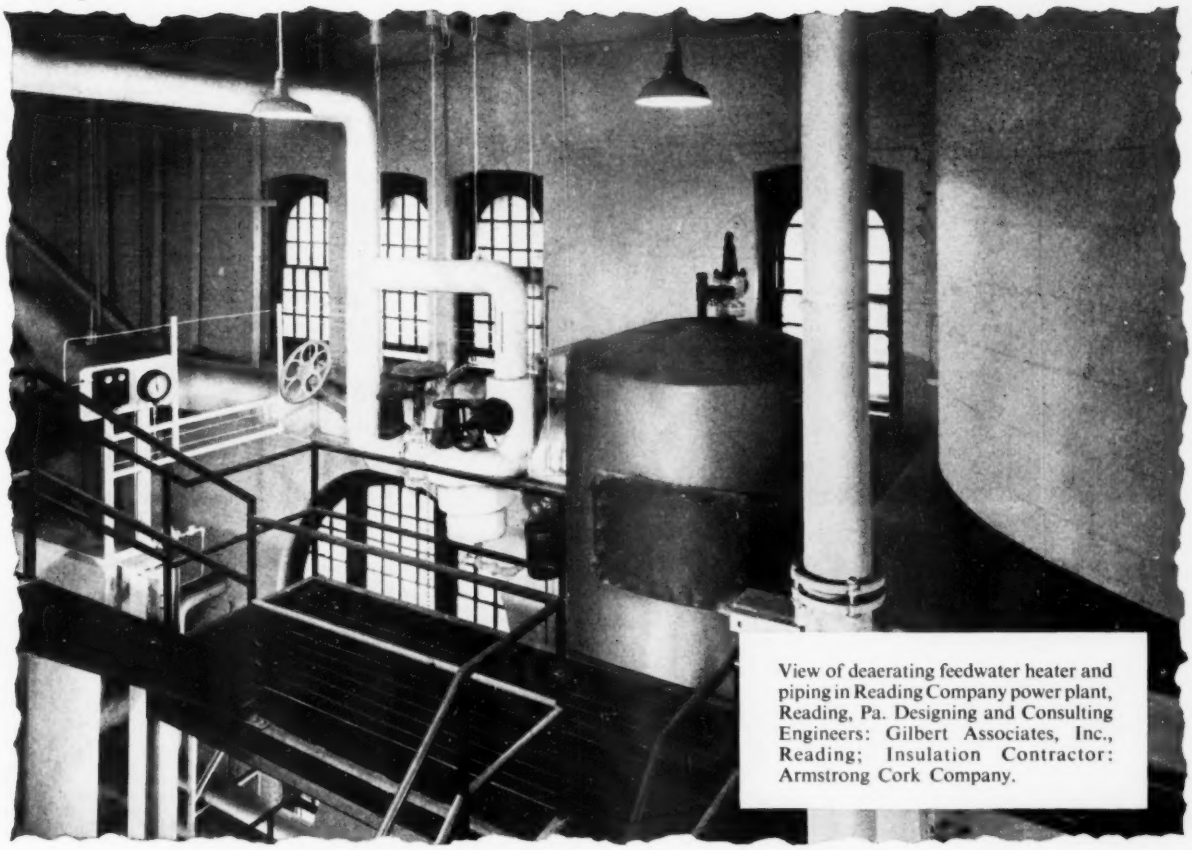
100 Fellsway, Somerville 45, Mass.
Offices in Major Cities
Jerguson Tress Gage & Valve Co., Ltd., London, Eng.
Pétrole Service, Paris, France



View of deaerating feedwater heater and piping in Reading Company power plant, Reading, Pa. Designing and Consulting Engineers: Gilbert Associates, Inc., Reading; Insulation Contractor: Armstrong Cork Company.

"Featherweight" 85% MAGNESIA

USED IN MODERNIZATION OF READING COMPANY POWER PLANT

When the Reading Railroad recently modernized its repair shop power plant, "Featherweight" 85% Magnesia was extensively used. The illustration above shows some of the piping and feedwater heater which was covered with this dependable insulation.

For insulating piping and equipment with temperatures up to 600°F., "Featherweight" 85% Magnesia is unexcelled. It acts as an efficient insulator for a lifetime, too—unaffected by vermin, moisture, vibration, or temperature change. It is made in various shapes and thicknesses for easy application over any equipment or piping.

The K&M distributor in your area is an experienced applicator who will gladly tell you more about "Featherweight" 85% Magnesia. Call him today! Or, write directly to us for information.

Nature made asbestos...
Keasbey & Mattison has made it serve mankind since 1873

KEASBEY & MATTISON
COMPANY • AMBLER • PENNSYLVANIA
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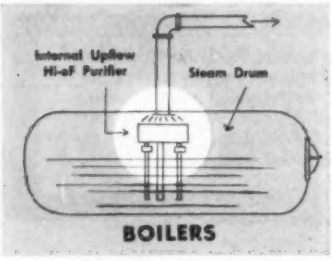
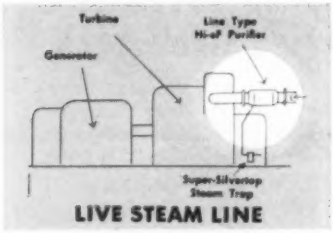
K&M best in asbestos

STEAM... CLEANER THAN A WHISTLE

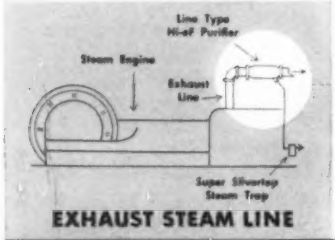
with Hi-eF PURIFIERS On the Job!



BOILERS



LIVE STEAM LINE



EXHAUST STEAM LINE

Clean steam means cheap steam and every engineer should consider the following uses of Hi-eF Purifiers:

(1) In boilers to keep steam clean, dry and hot . . . to stop carryover and permit boilers to be operated at higher capacities.

(2) Ahead of turbines, reciprocating engines, regulating valves and other costly steam equipment which eliminates any possibility of damage by slugs, entrained moisture, and scale.

(3) In exhaust steam applications to remove objectionable entrainment so the steam may be used profitably for heating, processes or even returned to the boiler as condensate.

Hi-eF Purifiers are the best buy in separating efficiency today. They involve a new two-stage centrifugal design proved far more effective than conventional separators in actual field tests. Every purifier carries a 99% entrainment removal guarantee. Despite their increase in separating efficiency they are easy to install and maintain. Without moving parts or filters, they never require cleaning or maintaining. Get the facts on how Hi-eF Purifiers make steam cheaper. Mail coupon today!

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THE V. D. ANDERSON COMPANY
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More FREE BULLETINS

Begins on page 163

chure. Purpose of equipment is reclamation and repurification of oils, coolants, solvents and industrial waters by removal of solids, solubles and volatile contaminants on continuous automatic basis. Bulletin A-943, U. S. Hoffman Mach Corp, Syracuse 6, N. Y.

43 **Packaged water** conditioning plant designed to chlorinate, coagulate, clarify, filter, neutralize, dealkalize and soften raw water supplies described in 8-page, illustrated bulletin 3869. Permutit Co, New York 36, N. Y.

44 **Filters** for liquid flows of 1.8 to 900 gpm and pressures of 125 to 1000 psi featured in 12-page, 2-color booklet. Applications, photos and dimensional drawings, case histories, selector chart and full page of hydraulic data included. Bulletin MK-0553, Cuno Engrg Corp, Meriden, Conn.

45 **Automatic pH**—control in boiler feedwater explained in reissue of technical bulletin 55. This is a reprint of a paper delivered by T T Sheen, president of the company. Milton Roy Co, 1300 E Mermaid Lane, Philadelphia 18, Pa.

46 **Chlorine feeders** — for sewage treatment and factors determining selection covered in technical information sheet No. 840-J37. Builders-Providence, Inc, 345 Harris Ave, Providence, R. I.

WELDING

47 **Welding**—of nickel alloy steels and a study of various welding techniques discussed in 44-page booklet. Tables, graphs and illustrations. Bulletin A-93, International Nickel, New York 5, N. Y.

48 **Special report**—prepared for the Zinc Institute entitled *Cathodic Protection with Zinc Anodes* covers mass of engineering data and information concerning the types of applications suitable for zinc anodes and desirable anode forms and methods of application. American Zinc Institute, 60 E 42nd St, New York 17, N. Y.

49 **Low hydrogen electrodes** covered in 8-page, illustrated technical bulletin. Includes history of electrode, effects and control of hydrogen, welding procedures and applications. Bulletin AR53-18, Alloy Rods Co, York, Pa.

50 **Fabrication of tubular** materials treated in new reference table, *Summary of Recommended Arc Welding Procedures for Various Steel & B&W Croloy Combinations.* TDC-155, Babcock & Wilcox Co, Beaver Falls, Pa.

51 **Welding hose** construction, performance data, recommended uses, sizes, working pressures, etc. discussed in 2-page, 4-color release. Cross section and cutaway photos incl. Quaker Rubber Corp, Tacony and Comly St, Philadelphia 24, Pa.

52 **Arc-welding** machines and various accessories for specific jobs covered in 44-page catalog. Photos of 20 models, full specs and electrical data included. Catalog 1340, Air Reduction Sales Co, 60 E 42 St, New York 17, N. Y.

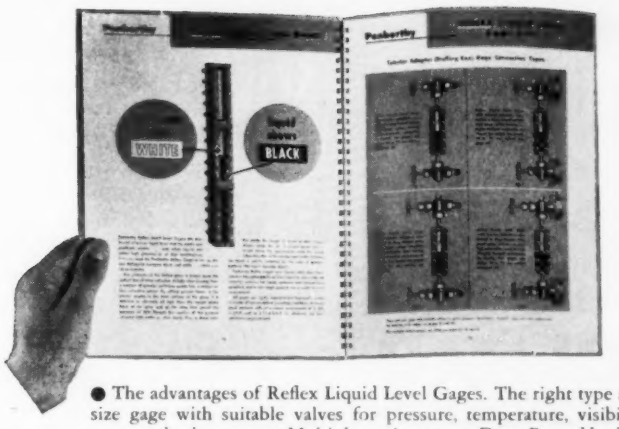
53 **Electrode-selector** chart presents information on mild-steel, low hydrogen-low alloy, low alloy-high tensile, hard-surfacing and stainless steel electrodes. Bulletin GEC-657E. Advantages of furnace and induction brazing presented in 12-page, 2-color, fully illustrated booklet. Bulletin GEA-5889, General Electric Co, Schenectady 5, N. Y.

MISCELLANEOUS

54 **Drafting machines** described in 20-page, 2-color booklet. Photos and data on various models including gravity compensated, track type, civil engrg and detail machines. Charles Bruning Co, 4700 Montrose Ave, Chicago, Ill.

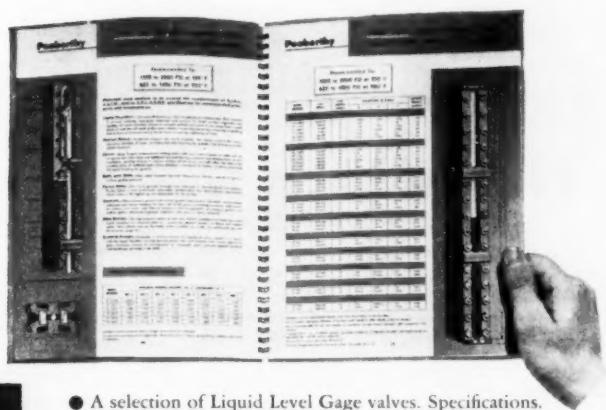
55 **Piping** and pressure vessels featured in 48-page booklet. Includes 28 pages of tables covering standard data on piping and pressure vessel stress values. Taylor Forge & Pipe Works, Inc, Chicago 90, Ill.

FACTS AT YOUR FINGERTIPS



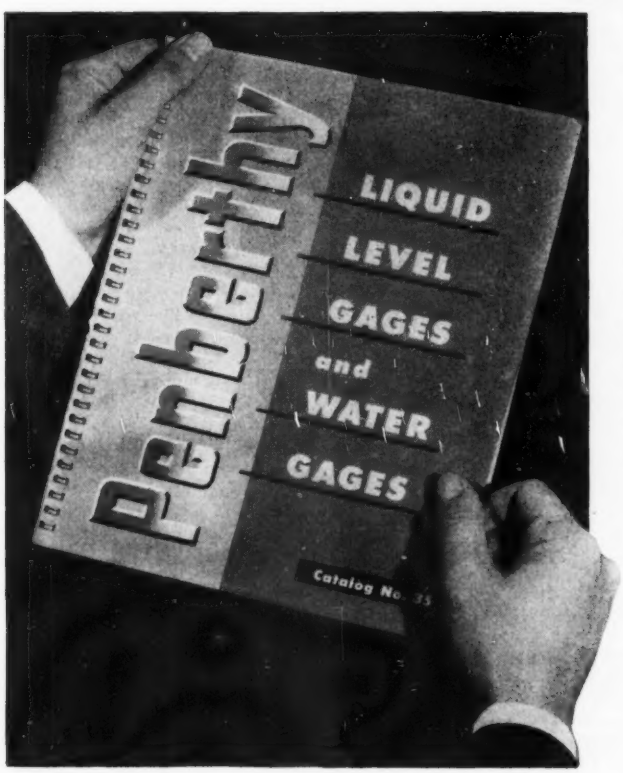
● The advantages of Reflex Liquid Level Gages. The right type and size gage with suitable valves for pressure, temperature, visibility range and valve centers. Multiple section gages. Drop Forged bodies. Pyrex glass. Basic and special designs.

● When to use Transparent Liquid Level Gage Sets. High pressure steam service. Adapters, valves, connections. Types available with recommendations.



● A selection of Liquid Level Gage valves. Specifications. "Floating Shank." Connections and special features.

● Metallurgical specifications. Gage glass and guard rods. Engineering service.



Penberthy's Catalog 35 is jam-packed with illustrated facts and specifications. It is your best guide to selecting the right liquid level gage sets at the most economical cost. In the complete Penberthy line, there are standard products for almost every application. Where your needs are special or unique, use the experience of almost 70 years to solve them. Take a tip from many thousands of satisfied users and write for your copy of Catalog 35.

Established 1886

PENBERTHY INJECTOR COMPANY

Division of the Buffalo-Eclipse Corporation

1281 Holden Ave., Detroit 2, Michigan

There's *Certain* satisfaction in products by PENBERTHY

Give your employees another safety plus — install Hendrick Shur-Site Treads for stairs and fire escapes. You cut down accident rates and improve working conditions with Hendrick treads because they afford a non-slipping, level walking surface — have 90% open area, do not obstruct light and ventilation.

CLIMB *in confidence...*

A safety-first, heavy flanged nosing-bar provides extra reinforcement and plainly marks the edge of each step. Bars are square edged, uniformly spaced for long, sustained life.

Ready to bolt directly to stair stringers, they're furnished in standard sizes or in special widths and lengths to meet specific requirements. For more complete data write Hendrick direct.

Hendrick MANUFACTURING COMPANY

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Sales Offices in Principal Cities • Perforated Metal • Perforated Metal Screens • Wedge-Slot Screens • Architectural Grilles • Mitco Open Steel Flooring • Shur-Site Treads • Armorgrids

Solve Sludge Problem with Nicholson's

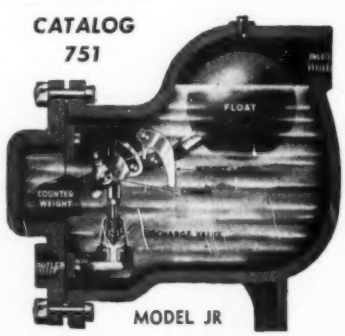
***New* AIR TRAPS**

With the introduction of an exclusive new oil-eliminating feature, Nicholson air traps now enable you to enjoy the advantages of the positive intermittent action of a float-operated air trap without the common problem of oil congealing on the mechanism and impeding or stopping its action. Other features of Nicholson air traps:

1) No air-wasting vent, such as is in all inverted bucket traps.
2) Positive water seal of valve.
3) Large orifice keeps valve clean, preventing blow-through.

Three types; pressures to 1500 lbs. These weight-operated traps also for steam.

CATALOG 751



MODEL JR

125 Oregon St., Wilkes-Barre, Pa.

W. H. NICHOLSON & CO.

TRAPS · VALVES · FLOATS

APPOINTMENTS

Corporation Executive Changes

Dominion Brake Shoe Co, a subsidiary of American Brake Shoe Co: Thomas E Akers, chairman; Kenneth T. Fawcett, president; Maynard B Terry, vice-president. **The Marley Co:** J. A. Cameron, executive vice-president and assistant general manager. **Chain Belt Co:** William C Messinger, secretary succeeding George D Gilbert, retired. **Babcock & Wilcox Co:** Paul J Utnehmer, member of the board of Tubular Products Division.

Rockand Light and Power Co: L Earle Merrow, a vice-president. **Bonney Forge & Tool Works:** Roger O Bay, a vice-president. **Pacific Gas & Eectric Co:** Robert H Gerdes, member of the board succeeding W G B Euler, retired. **Virginia Eectric & Power Co:** George E Kidd, vice-president succeeding T Norman Jones Jr, retired.

Engineer Changes

Crosby Steam Gage & Vave Co and **Ashton Valve Co:** James L Corcoran, director of engineering. **Santa Fe Tank & Tower Co:** Jack Slough, assistant chief engineer; Dr. Joseph Lichtenstein, eastern district manager. **Philadelphia Electric Co:** Theodore S Fetter, Jr, staff engineer, Mechanical Engineering Division. **Montana Power Co:** H E Chambliss, chief engineer.

New Sales Vice-Presidents

Kuljian Corp: Herbert G Johnson, formerly general manager of Heat Transfer Division, C H Wheeler Mfg Co. **Chain Belt Co:** A R Abelt, formerly vice-president in charge of Field Forces. **Georgia Power Co:** C M Wallace Jr, succeeding Charles A Collier, retired. **Multi-Amp:** J L Wagoner, former Westinghouse executive.

New Sales Managers

Bristol Co: Ernest Nuber, instrument division. **Darling Valve & Mfg Co:** Frank B Kreider, general sales. **Riley Stoker Corp:** Robert K Griffith, Philadelphia district succeeding R M Bassett, retired. **Cochrane Corp:** Justin J McCarthy, Philadelphia district sales office. **Servel, Inc:** G Howard Christine, contract sales division; J R Lumpkin, Miami appliance sales; Frank D O'Sullivan, Philadelphia appliance sales; Early Cunningham, Albany appliance sales; C Sidney Johnston Jr, Milwaukee appliance sales.

Worthington Corp: L J MacKenna, Tulsa office. **Westinghouse Electric Corp:** E C Delano, Boston district; E G Horton, Connecticut Valley district; W C Wood, Newark district; H E Dralle, New York City district; H B Vidal, New York State district. **National Gypsum Co:** Charles D Harless, New York district.

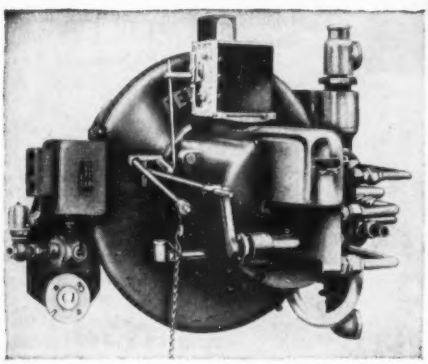
NO MATTER WHAT THE DEMAND

THERE'S A

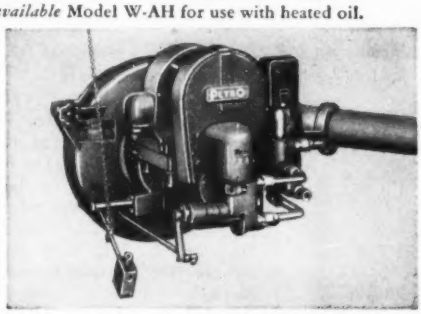
Petro

INDUSTRIAL OIL BURNER

to handle it!



Shown above Model WA for use with cold oil.
Also available Model W-AH for use with heated oil.



Model G-W Combination oil-gas.

Cut Fuel Costs with Heavy Fuel Oil

Petro rotary oil burners are built for firing all types of boilers up to 600 boiler horsepower, and also for many other industrial applications. They are designed to burn the low-cost, heavy fuel oils with complete reliability, Petro oil burners slash fuel costs two ways—they burn the *lower priced oils*, and they do it with *outstanding efficiency*. Fluctuating steam demands are answered automatically with Petro modulating flame control. Thousands of owners will tell you that Petro Industrial Oil Burners and combination oil-gas burners are fuel savers, labor savers and trouble savers, and their dependability is traditional.

Your heating contractor can tell you about Petro burners. Turn to "Oil Burners" in telephone book yellow pages. See catalog in Sweet's Architectural File, or mail coupon below.

INDUSTRIAL AND COMMERCIAL OIL, GAS AND COMBINATION OIL-GAS BURNERS, RESIDENTIAL OIL BURNERS, OIL AND GAS FURNACES AND BOILERS

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In Canada: 2231 Bloor Street, West, Toronto, Ontario.

Please send me the Petro catalog of commercial-industrial oil and gas-oil firing equipment.

Name_____

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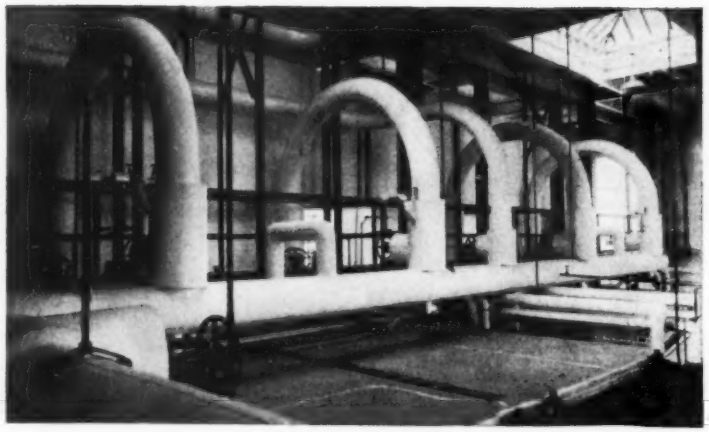
NEW HEAT SAVING EFFICIENCY



...with MUNDET "CUSTOM MOLDED" 85% MAGNESIA

Now available in pipe covering and block insulation, Mundet 85% Magnesia permits new heat-saving efficiency. Precision manufacturing on the latest type of automatic equipment insures uniform standards. Extra durability is built into the insulation. It does not "powder", settle or disintegrate. It is unaffected by either steam or water leakage. It maintains an attractive, smooth finish. Precision pipe fit is assured, with no spaces left for the escape of heat. You benefit from the most modern manufacturing facilities for the production of heat insulation. Write for specification information and recommendations. Mundet Cork Corporation, Insulation Division, 7101 Tonnelle Avenue, North Bergen, N. J.

MUNDET

MUNDET

INSULATION FOR HIGH & LOW TEMPERATURE

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ATLANTA 339-41 Elizabeth St., N.E.
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CHICAGO 16 2601 Cottage Grove Ave.
CINCINNATI 2 427 West 4th St.
DALLAS 1 601 Second Ave.
DETROIT 21 14401 Prairie St.
HOUSTON 1 Commerce and Palmer Sts.
INDIANAPOLIS 15 E. Washington St.
JACKSONVILLE 6, FLA. 800 E. Bay St.
KANSAS CITY 7, MO. 1428 St. Louis Ave.
LOS ANGELES (Maywood): 6116 Walker Ave.
NEW ORLEANS 16 315-25 N. Front St.
PHILADELPHIA 39 856 N. 48th St.
ST. LOUIS 9 3176 Brannon Ave.
SAN FRANCISCO 7 440 Brannan St.

In Canada: Mundet Cork & Insulation, Ltd. 35 Booth Ave., Toronto

More APPOINTMENTS

Begins on page 250

Electric Storage Battery Co: L M Gay, Cleveland branch succeeding W P Roche, now on indefinite leave of absence.

Erie City Iron Works: Theodore Hammond, assistant sales manager. **Elliot Co:** E A Humble, assistant manager, Boston office; M C Seeman, assistant manager Cleveland office; O M Sievert, assistant manager, Kansas City office.

New Sales Engineers

Riley Stoker Corp: William H Hardie, New York office. **Trane Co:** Raymond O Goodman, Chattanooga office; Robert E Murphy, Milwaukee office; Richard E Haskins, Oklahoma City office. **Norton Co:** Burton G Ebbeson, Worcester area; Charles M Wellons, Philadelphia district office; Gerald H Lusher, Louisville-Cincinnati area.

Reliance Electric & Engrg Co: L E Blackwell Jr, Charlotte, N. C. office. **Automatic Transmission Co:** Calvin J Timmins of J Alex Gordon & Co, Detroit representative. **Ansul Chemical Co:** Jay H Jarrett, refrigeration division, south-central area.

New Distributors

For **Servel, Inc:** State Distributing Co, Inc, 3500 W Pierce St, Milwaukee, Wis. For **General Electric Co,** Carboloy Dept: Henry Walke Co of Norfolk Va. and Charlotte, W Va. For **Graybar Electric Co:** branch office at 655 South "H" St, San Bernardino, Calif. under R P Sager. For **C F Casella & Co Ltd** of London: Mine Safety Appliances Co of Pittsburgh. For **Morse Chain Co:** Abrasive & Supply Co, 15443 Woodrow Wilson Ave, Detroit 3, Mich.

New Representatives

For **Arthur D Little, Inc:** midwest liaison office in the Board of Trade Bldg. Chicago 4, Ill. For **Baker-Raulang Co:** Hohl Industrial Sales Co, Inc, 2603 Main St, Buffalo, N. Y.; Baker-Lull Associates, 25 South Easton Rd, Glenside, Pa.; A & W Engrg Co, 2222 N W 14th St, Miami, Florida. For **Cleaver-Brooks Co:** D E McCulley Co, 1903 Jones St, Omaha 2, Neb.

For **Flexible Steel Lacing Co;** John A Marshall, Oregon-Washington territory. For **Michigan Tool Co,** Cone-Drive Gears Division: Walter H Douglas, greater New York area. For **American Cyanamid Co:** R W McCullough, technical field service representative to the rubber compounding industry. For **Simplex Valve & Meter Co:** Ralph N Cramer, 412 Ashburton Rd, Columbus, Ohio.

New Names, Locations

Vanton Pump & Equipment Corp: formerly Vanton Pump Corp; manufacturing plant is now located on premises of its affiliate company, Cooper Alloy Foundry

Guaranteed TO SHUT TIGHT*

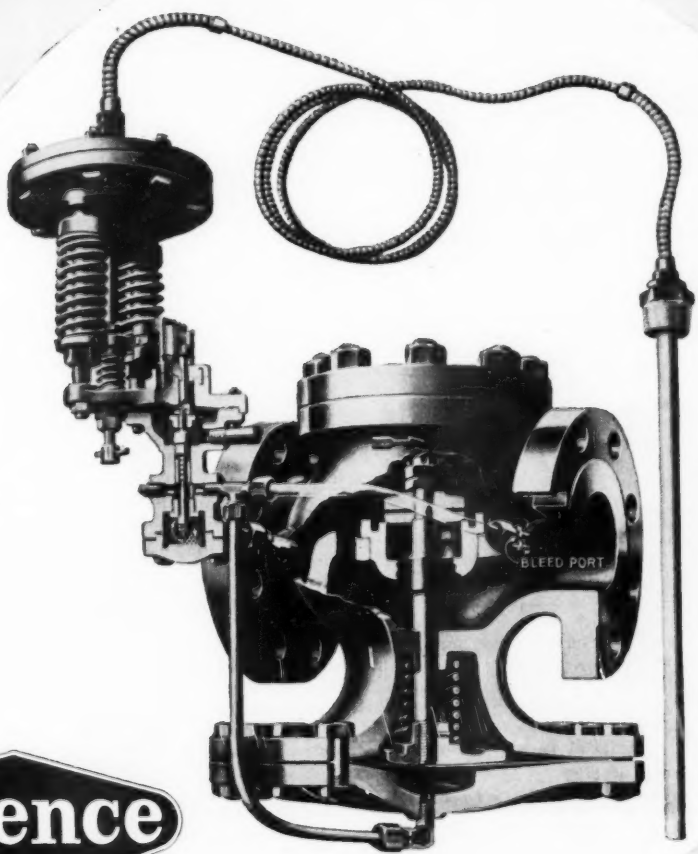
* When equipped with a SECO Metal Seat and Disc on steam service and protected by an approved Strainer, a Spence Regulator is guaranteed to shut tight when the demand for steam ceases.

Expensive steam leaks due to a lack of absolutely tight shutoff are eliminated in Spence Temperature Regulators. Here is why we can make such a guarantee:

First, our temperature regulators are of the single seat design. Seats and discs are made of durable SECO Metal. More than 20 years experience in thousands of installations has failed to produce a single case where SECO Metal has been cut by steam.

These plus other design features explain why Spence Temperature Regulators function dependably and accurately year after year without requiring expensive repairs or special attention.

Want more facts? Write for Bulletin T50 giving full details.



SPENCE
TYPE ET150
Temperature
Regulator

Spence

SPENCE ENGINEERING COMPANY, INC.
WALDEN, NEW YORK

SE-129

this Bulletin...

Gives you

THE "INSIDE STORY" ON THE GREATEST PROGRESS IN SAFETY VALVES FOR OVER 50 YEARS!

Yes, IT'S ALL ABOUT THE NEW

LONERGAN
UNI-LINE
41-W-200 SERIES

NO OTHER VALVE LIKE IT

The UNI-LINE features:

- a *Much Higher capacity* per size, than any other safety valve.
- a free-acting, self-aligning disc.
- a *"floating" guide* (readily adjustable for control) . . . assists in opening and closing action, as well as affording an additional self-aligning feature.
- a Disc and Disc holder of *forged copper alloy*, not castings.

For full details about the money-saving, maintenance-free advantages of these "features", plus valve data and specifications, write for your free copy of this new UNI-LINE 41-W-200 Series Bulletin.

Lonergan
J. E. LONERGAN COMPANY
Established 1872
RACE & 2nd STREETS • PHILA. 6, PA.

More APPOINTMENTS

Begins on page 250

Co of Hillside, N. J. **United Metal Craft Co:** formerly United Stove Co, a subsidiary of Gar Wood Industries, Inc.

Clark Equipment Co: John J Shand, southeastern regional sales manager, has moved his headquarters from Norfolk, Va. to 161 Spring St Bldg, Atlanta, Ga. **Pocahontas Fuel Co:** Earl C Robertson, vice-president in charge of sales, has moved his office and the general sales office from New York to the Terminal Tower, Cleveland, Ohio.

Institute Elections

American Society of Civil Engineers: Daniel V Terrell of Lexington, Ky., president; Enoch R Needles of Summit, N. J., vice-president for Zone 1; Mason G Lockwood of Houston, Texas, vice-president for Zone 4. **Water Conditioning Foundation:** C L Scribner, assistant general manager of Elgin Softener Corp, chairman of the executive board. **Battelle Institute:** A C Richardson, Technical Director. **Bituminous Coal Research, Inc:** Elmer R Kaiser, from assistant director of research to associate director; C E McGlaughlin, from special representative to assistant to the president.

Obituaries

A Albert Klein, 64, assistant director of research and development at Norton Co, August 25th.

Littleton C Barkley, 51, General Sales Manager, West Coast Division of Raybestos-Manhattan, Inc, August 27th.

John Winterbottom, 62, power engineer at McLean Hospital, Waverly, Mass., August 29th.

E Clinton Jansen, 74, former chief hydraulic engineer for Public Service Co of Colorado, September 1st.

Chilean State Railway will install two new 3000-kw ignitron substations on its heavily-traveled electrified line between Santiago and Valparaiso. The units, ordered from Westinghouse Electric International Co, will improve service between the country's capital and its chief port. Each substation will consist of an ignitron rectifier plus switchgear and transformers. Ignitrons, smaller than motor-generator sets of same capacity, provide large quantities of dc energy from an ac source without the use of moving parts.

A documentary motion picture, *Decision for Chemistry,* depicts the role of the chemical industry in American life. Produced by Monsanto Chemical Co, the film is not an "inventory picture" nor is it a tour of the company's plants and offices. Rather is it a study of an industry as seen through some of the experiences and events at Monsanto. The story pattern is simple—looking at yesterday to see today, looking at today to see tomorrow.

Check These Advantages

TENNESSEE CORPORATION
ferri-floc
FERRIC SULPHATE

✓ ① Coagulation over wide PH ranges, color, turbidity and manganese removal.
✓ ② Rapid floc formation and rapid settling.
✓ ③ Increased filter runs.
✓ ④ Quality effluent low in iron and aluminum.
✓ ⑤ Excellent taste and odor control.

Ferri-Floc is a partially hydrated ferric sulphate. It is a stable, free flowing, granular salt. It can be fed with few modifications through any standard dry feed equipment. Being partially hydrated, it is mildly hygroscopic, thus permitting easy handling as well as long storage periods in closed hoppers.

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Coagulation of surface or well waters. Aids taste and odor control. Effective in lime soda-ash softening. Adaptable to treatment of nearly all industrial water or wastes.

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Coagulation over wide PH range. Efficient operation regardless of rapid variations of raw sewage. Effective for conditioning the sludge prior to vacuum filtration or drying on sand beds.

SULPHUR-DIOXIDE

SULPHUR-DIOXIDE HIGHEST QUALITY SO_2

SULPHUR-DIOXIDE is effectively used for dechlorination in water treatment and to remove objectionable odors remaining after purification.

COPPER SULPHATE

COPPER SULPHATE

COPPER SULPHATE will control about 90% of the microorganisms normally encountered in water treatment plants more economically than any other chemical.

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Let us send you free literature on the above products. Send card or letter to Tennessee Corporation, 617-629 Grant Building, Atlanta, Georgia

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TENNESSEE CORPORATION
617-29 Grant Building, Atlanta, Georgia

Another reason why

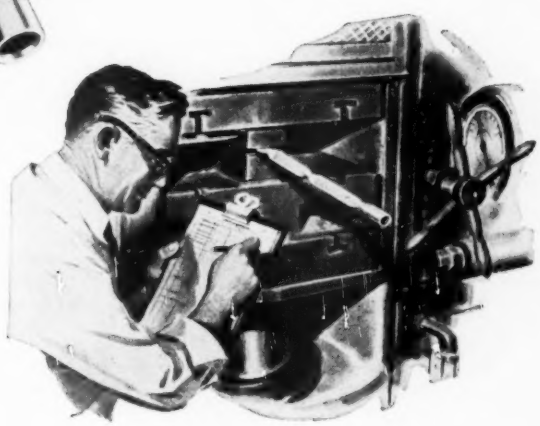
Chase

Antimonial Admiralty Tubes last longer!

Yes, you can *count* on Chase Antimonial Admiralty Condenser Tubes to give you many years of satisfactory service.

Chase Condenser Tubes are rigidly controlled for quality during manufacture, and various tests are applied when the tube is finished. The flattening test mentioned below is a good example. Wall thickness, diameter, surface finish, concentricity and accuracy of length are carefully determined.

So, for condenser tubes that last and last, *remember:* insist on Chase Antimonial Admiralty!



PUTTING THE SQUEEZE ON IMPERFECTIONS...
This Chase technician is performing a "flattening test" which is an indication of soundness and freedom from hidden defects. You are assured that tubes passing this test will satisfactorily withstand bending or end flaring.

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   (c) *Indirect water heating coils for Kewanee Boilers*
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More POWER NEWS

Begins on page 148

mend that electrical ground wires connected to pipes containing corrosion prevention devices should be rearranged or connected elsewhere. The Committee emphasizes that if, after one of these devices has been installed, the electrical circuits are not grounded in accordance with the National Electrical Code, serious danger to the safety of persons and property may result.

Against this background and in line with its responsibilities, the Committee then recommends extreme caution in the application of corrosion and scale preventing devices lacking any apparent basis of sound scientific principles and having no adequate engineering performance data.

Coming Events

Nov 2-6—American Institute of Electrical Engineers, fall general meeting, Muelebach Hotel, Kansas City, Mo. For details write AIEE, 33 W 39th St, New York 18, N. Y.

Nov 29-Dec 4—American Society of Mechanical Engineers, annual meeting, Statler, McAlpin and Governor Clinton Hotels, New York City. For details write O B Schier II, secretary, ASME, 29 W 39th St, New York 18, N. Y.

Nov 30-Dec 5—24th Exposition of Chemical Industries, Commercial Museum and Convention Hall, Philadelphia, Pa. For details write 24th Exposition of Chemical Industries, Publicity Dept, 480 Lexington Ave, New York 17, N. Y.

Jan 25-27, 1954—Plant Maintenance & Engrg Conference, Hotel Conrad Hilton, Chicago, Ill. For Details write Banner & Greif, 18 E 41st St, New York 17, N. Y.

D C McGraw *Continued from page 148*

Graw-Hill then operated its own printing plant in its building at 36th St and 10th Ave. In 1924 he assumed supervision of the operation of the building and of the printshop.

Since 1933, when he was made Secretary of the company and put in charge of production and manufacturing, Mr McGraw has been responsible for the handling of all contracts for printing and binding, engraving and paper supply for all McGraw-Hill operations.

In 1945, Mr McGraw became vice-president for manufacturing and general services, the position he has held until being elected president. In 1950 he became a director of McGraw-Hill Book Co, a subsidiary, and of the Newton Falls Paper Mill in which McGraw-Hill has a half-interest.

Mr McGraw participates in the Sum-

DARLING VALVES

INSIDE STORY...

on trouble-free valve performance

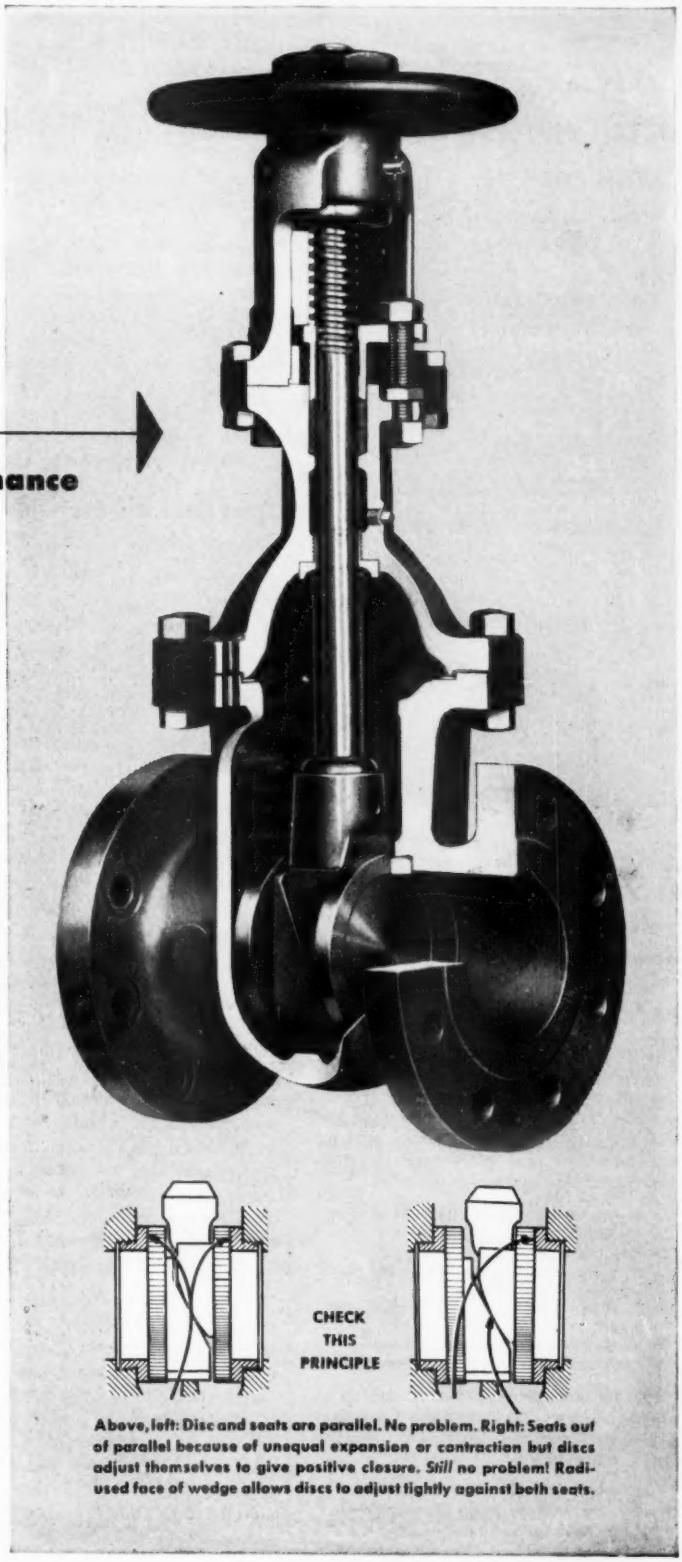
Install DARLING Revolving Disc GATE VALVES

Just what the doctor ordered . . . that's what users say about Darling fully revolving double disc, parallel seat gate valves. *Reason:* These unique valves adjust automatically to compensate for valve body distortion.

Moreover, Darling gate discs, independently hung from the upper wedge and free to revolve completely, change their seating position at each closing. This means uniform wear distribution. Valves work better and last longer, require less attention, less maintenance.

Wide Range Of Sizes And Types

If you're not already a Darling revolving disc gate valve user, let us prescribe the valve you need to cure *your* valve trouble. Darling gate valves come in a wide range of types and sizes . . . and for pressures up to 1500 pounds. Simply outline your particular service needs or ask for a complete descriptive bulletin.



Above, left: Disc and seats are parallel. No problem. Right: Seats out of parallel because of unequal expansion or contraction but discs adjust themselves to give positive closure. *Still* no problem! Radiused face of wedge allows discs to adjust tightly against both seats.

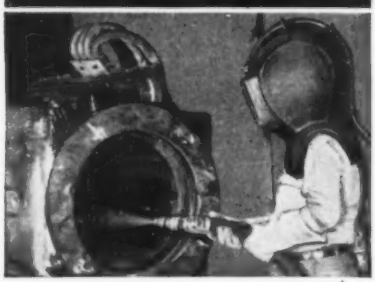
DARLING VALVE & MANUFACTURING CO.

Williamsport 8, Pa.

Manufactured in Canada by Sandilands Valve Manufacturing Co., Ltd., Galt 19, Ontario

YES!

Pangborn's "Corn Grit" AC-4 Blast Machine CLEANS Diesel-Electric Motors WITHOUT SOLVENTS!



SAVES TIME BECAUSE DRYING PERIODS ARE UNNECESSARY!

The Pangborn AC-4 Blast Machine cuts down-time to less than half by *eliminating waiting* for parts to dry . . . by *cleaning faster* . . . by *requiring no dismantling* in most cases. It uses soft 20-mesh corn cob grits to remove dirt, grease, old paint, etc. quickly and efficiently, without harming coils and other delicate parts. Look at these features:

- Cleans in less than half the time of other methods
- Requires no drying periods
- Material costs average 90% less than old-fashioned methods
- Does better job, leaves parts clean and bright
- Eliminates toxic hazards of solvents
- Portable—easily moved from job to job

Write for complete information, telling us what you clean, to: PANGBORN CORPORATION, 90 Pangborn Boulevard, Hagerstown, Maryland.

Look to Pangborn for the latest developments in Blast Cleaning and Dust Control equipment.

Pangborn

BLAST CLEANS CHEAPER
with the right equipment for every job

More POWER NEWS

Begins on page 148

mit Red Cross Campaign, the annual campaign of the Overlook Hospital at Summit, the "Annual Giving" Campaign of Princeton University and the Building Fund of the Presbyterian Church at Madison. He is a member of the Baltusrol Club of Springfield and of the Pine Valley Club.

Mr and Mrs McGraw have a daughter, Mrs J T McBroom of Roanoke, Va., and two sons, Donald C Jr, a member of the advertising sales staff of Product Engineering, and John Louis, now in the U. S. Navy.

Other officers of the McGraw-Hill Publishing Co continue unchanged.

Some Pro's and Con's on Atomic Energy

NORTH CAROLINA STATE COLLEGE and the Atomic Energy Commission have signed an agreement that opens the way for immediate operation of the first university-owned nuclear reactor in the nation. Under this contract, AEC will loan the College enough fissionable uranium 235 to fuel the "Raleigh Research Reactor" recently constructed in a new building on campus.

This agreement culminates a project that has been under way since June 1950 when the college, under contract with the AEC, initiated design and construction of a low-powered research reactor. The reactor assembly and most of the pre-operational tests are now complete. Loading of fuel and initial operation will begin as soon as the fissionable material arrives from AEC.

The reactor, designed and built with university funds, will supply experience to students in nuclear engineering, a new curriculum initiated by the college in 1950. North Carolina State was the first educational institution to approach AEC with a proposal to design, build and operate a research reactor. Since that time, several other institutions have proposed similar projects.

RICHARD MARCH, staff assistant in the reactor division of the Chicago operations office of the AEC, claims that it is one thing to produce power by nuclear fission, another to do it economically. Speaking at a recent meeting of the Illinois chapter of the American Society of Heating and Ventilating Engineers, March stated that our estimated future power consumption makes necessary a fuel substitute.

Industrial feasibility of nuclear power, he continued, depends on many factors and, in his opinion, such power cannot compete now or in the near future with established industrial fuels.

(*Continued on page* 260)

DOW CORNING 5 SILICONE COMPOUND

Repels Water
Protects
Lubricates
Insulates

Pole-Top Disconnect Switches

Proved effective as a switch lubricant; also as a release agent to keep switches operable under icing conditions.

Switch Clips, Hinges and Bearings

A mixture of zinc dust with Dow Corning 5 Compound serves as a lubricant and oxidation inhibitor. Zinc dust assures adequate conductivity. One application gives 2 to 3 years' protection.

ASCR Wire Splices

Applied to both the aluminum and steel conductors, compound flows under pressure around the spliced wires to fill voids, improve heat conductivity, exclude moisture and inhibit formation of oxide film.

5 kv Service Entrance Cable

Useful as a filling compound to prevent migration of water along rubber insulated 5 kv service cable when used without potheads.

Dow Corning 5 silicone compound remains stable at temperatures ranging from −70 to 400°F.

***WRITE TODAY* for more information on this compound and on other silicone products that: maintain high surface resistivity on insulators and electronic parts; preserve lineman's protective equipment.**

Address Dept. DU-11

DOW CORNING SILICONES

DOW CORNING CORPORATION
MIDLAND, MICHIGAN

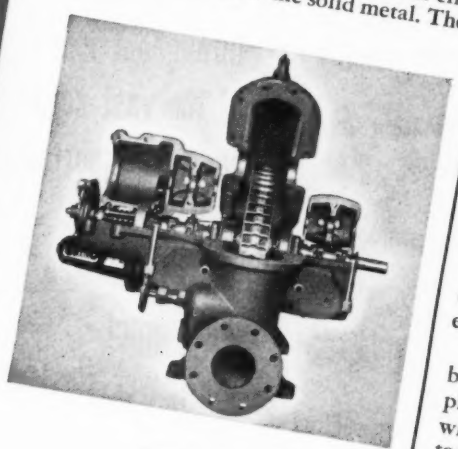
TERRY

The rotor of a Terry Solid-wheel Turbine is a single forging of special composition steel. It is first rough turned in two operations, as illustrated, and then two cuts are taken to mill the semi-circular buckets from the solid metal. The wheel at the top has been finished, ready for mounting on the shaft. *The result is a single-piece wheel with no parts to loosen or work out.*

As the only function of the blades is to form a series of pockets, wear of the blades is of little consequence and does not materially affect the horsepower or efficiency. The important part of the bucket is the back, or bottom, which is a solid forging.

It is impossible for the blades to foul. They have large clearances, and are further protected by the projecting rims at the sides of the wheel. As the side clearances are also very large, end play can do no harm.

The Terry Solid-wheel Turbine is an extremely reliable piece of equipment. Why not write for complete details today?

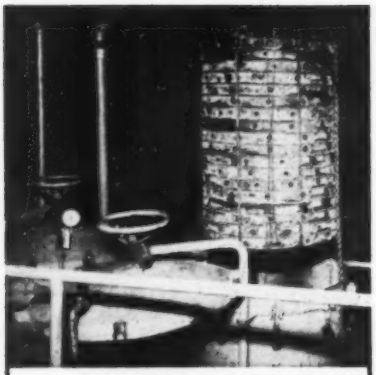


THE TERRY STEAM TURBINE CO.
TERRY SQUARE, HARTFORD 1, CONN.

TT-1188

Memo

Send for a copy of bulletin S-116 which describes the many advantages of the Terry Solid-wheel Turbine.



Leaf assembly being removed from one of three vertical filters at B. F. Nelson.

How B. F. Nelson Mfg. Co.

increased condensate in boiler feed 70%

with SORBO-CEL®

When B. F. Nelson Mfg. Co. added new 425-psi boilers, oil in condensate was an expensive problem . . . until they switched to Sorbo-Cel filtration.

Average oil concentration in old boilers was 65 ppm. Concentration in condensate receivers ran 33.4 ppm, mostly emulsified. About 50% of boiler feed was condensate. Problem: to keep oil out of new boilers. *By comparing methods, they found that filtration with Sorbo-Cel . . . a specially processed diatomite filter aid . . . did the best job.*

Sorbo-Cel slurry is fed into condensate to attract oil and hold it until it reaches filters. Sorbo-Cel collects on plates and builds up a highly porous cake. Operation is continuous until there is no more room for cake between plates—usually 70 hours.

Today, 85% of boiler feed is condensate. Labor-and-material costs are only 1.7 cents every 1000 lbs. Since B. F. Nelson produces two million pounds of steam a day, savings from reclaiming such a high percentage of condensate can readily be imagined.

For further information about Sorbo-Cel filtration mail the coupon below.

Johns-Manville

SORBO-CEL

Johns-Manville
Box 60, New York 16, N. Y. POW-11

Please send me free bulletin giving advantages of Sorbo-Cel filtration.

Name_____

Company_____

Address_____

City_____ State_____

More POWER NEWS

Begins on page 258

March said that plutonium produced in breeder reactors must be sold to the government if the reactor is to be operated economically. He pointed out that cost of uranium is a negligible part of total cost, so that fuel costs, fuel savings and thermal efficiencies are not too important. For this reason he does not believe that it will be necessary to produce power by means of high temperature, high pressure steam requiring the use of relatively expensive piping alloys.

Allegheny Ludlum Steel Corp has started an expanded program for the production of zirconium strip and other shapes for atomic energy applications. This program is the result of over two years research and production experience in melting and shaping zirconium metal. In this work, Allegheny Ludlum has been cooperating with the AEC's Bettis Plant in Pittsburgh.

Zirconium is especially suited to certain reactors because it wastes few neutrons and has a high resistance to certain types of corrosion. However, the metal's usefulness in reactors depends on the elimination of hafnium, an element that is present as a contaminant in natural zirconium. The Oak Ridge National Laboratories of the AEC developed a method to remove hafnium and to obtain pure zirconium in sponge form. Allegheny Ludlum has become the first private organization to go into melting this sponge into ingots.

U. N. Will Spend $30-million On Korean Power Facilities

Reconstruction of South Korea will include a foreign expenditure of close to $30-million for rehabilitation and expansion of electric power generating capacity. The first stage of the program will get underway shortly with the repair of 17 stations at an estimated cost of $3.6-million for foreign engineering and equipment.

Firms bidding for the reconstruction contract are: Utah Construction Co; Vinnell Corp; Gilbert Overseas Corp; Adrian Wilson & Associates; Kuljian Corp; Morrison-Knudsen International Co; Burns & Roe; Daniel, Mann, Johnson & Mendenhall; Rogers Engrg Co, Inc; U. S. Consultants Inc in association with Grove, Sheppard, Wilson & Kruge and Sanderson & Porter. Supervision of the contract falls to the Korean Civil Assistance Command (KCAC), a subsidiary unit of the U. S. Army. The dollars have been made available by the United Nations Korean Reconstruction Agency (UNKRA).

(*Continued on page* 262)

This message from

Power

appeared recently in Business Week to remind management men throughout industry of the vast scope and key importance of power and of the men who direct the power services

What's this fellow afraid of?

We believe Mr. Malenkov and his friends, when measuring us, are concerned with something a lot less dramatic, but perhaps more *important*, than most people think.

We don't believe they spend nearly as much time counting our bombs . . . as they spend counting our kilowatts.

Surely there just can't be any doubt that America's powerful punch is our ability to produce goods. In overwhelming, never-ending, suffocating quantities. And behind every article or service we perform is *power*.

There's a relatively small community of men who create and deliver that power wherever it is needed.

There are the engineers who design and construct the huge power plants we call utilities . . . the engineers who operate those utilities and send raw power on its way . . . the men in industry who receive it, sometimes make their own power, and always transform it into its many magic forms of heat, steam, motor power, cool air, and so on.

Lastly, there are the men who make the equipment that makes the power that makes the wheel turn.

The great, great majority of all these men have one habit in common. They read POWER magazine.

The reason they read it is that for more than 70 years it's been POWER's job to bring these men the latest news and finest details of their fast-moving field of work.

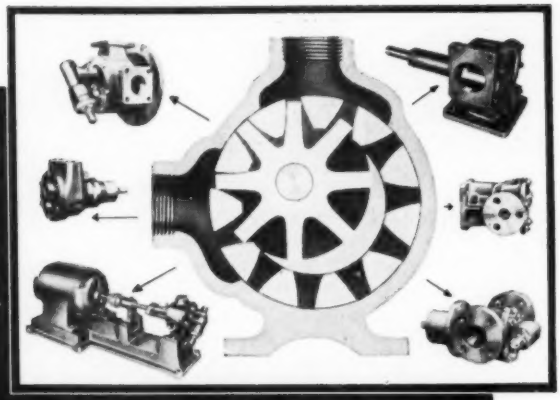
Because the power field, thank goodness, is fast-moving. In just 15 years we've put 2 more horsepower behind every worker in the United States. In those same 15 years the cost of energy has *dropped by 21%*.

That's why it behooves most management men to ask questions and get advice about their own plant's power network. Are you sure it's as modern and efficient as it should be?

Your power engineer knows. Better ask him.

One of America's primary industrial media and a member of the Audit Bureau of Circulations

McGRAW-HILL . . . ABP



SAVE *with* VIKING ROTARY PUMPS

BUILT TO FIT YOUR JOB!

With over 600 standard models and many more special units, from which to choose you are assured of a Viking rotary pump built to fit YOUR job.

All are constructed in the time-proved, most-copied of all rotary pump designs—the original Viking "gear-within-a-gear" principle.

This is the principle that assures fast, self priming; smooth even discharge; quick, easy mounting; low power requirements; adaptation for either light, volatile liquids or heavy, viscous liquids.

VIKING AN HONORED NAME IN PUMPING

Send your pumping problem today and ask for folder 53SW.

See Our Catalog in SWEETS

VIKING PUMP COMPANY
CEDAR FALLS, IOWA

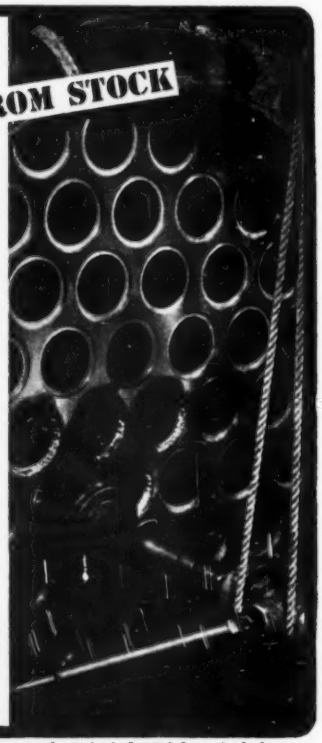
BOILER AND PRESSURE TUBES.. FROM STOCK

Murray currently maintains the largest and most complete warehouse stocks of boiler and pressure tubes in the country. From our modernly-equipped warehouses we can service your small or large tube requirements—promptly from warehouse stocks. Hundreds of tube users repeatedly rely on Murray for this dependable service.

When in need of boiler, condenser, heat exchanger, evaporator, stationary, marine or railroad tubular equipment, call a Murray warehouse first and be sure of quick and dependable tubing service.

Photo courtesy of The M. W. Kellogg Co., Inc.

WRITE FOR CURRENT STOCK BULLETIN



7271

A B MURRAY CO INC
ESTABLISHED 1845
ELIZABETH, N. J. McKEESPORT, PA.

Other Murray products include stainless steel pipe, tubing and fittings, IPS pressure tubing, seamless cold-drawn and hot finished mechanical tubing, seamless and welded pipe, JIC hydraulic tubing, carbon steel welding fittings and all types of tube fabricating to order.

7271

More POWER NEWS

Begins on page 260

Repairs included in the project include power plants, dams, substations, transformer stations and transmission lines. This should boost South Korean generating capacity to almost 100,000 kw. Present generating capacity is 53,000 kw supplemented by 30,000 kw from electric barges supplied by the United States.

Power requirements, as estimated by the Prime Minister's Office of Planning, are 130,000 kw in 1954 with a gradual rise to 255,000 kw in 1957. If the planning Office is correct, additional repairs, above those covered by the 17 station project, are necessary for distribution and transmission lines. The Office's overall estimate called for $4½-million of foreign equipment for distribution and transmission alone. It also hopes to spend $1½-million for steel towers to replace some pole lines. Korean timber is "so poor" that pole replacement is necessary every two or three years.

The current reconstruction program will meet American specifications and standards, although originally almost all Korean equipment was of Japanese manufacture. It is considered likely that only a part of the project's equipment will be purchased from Japan. Bids for new construction contracts will be open to all nations. UNKRA, under the direction of Mr Tyler Wood, will be the operating agency for the general industry program. Wood is the newly appointed American economic coordinator for Korea.

NBS, AEC Open $3½-million Low Temperature Engineering Lab

A MAJOR LOW-TEMPERATURE engineering facility consisting of a liquid-hydrogen plant and a cryogenic laboratory is now in operation at the National Bureau of Standards site at Boulder, Colorado. Known as the *NBS-AEC Cryogenic Engineering Laboratory*, the new $3½-million installation makes possible large-scale production of liquefied gases not previously available in sufficient quantity for laboratory and industrial development and testing.

Dr F G Brickwedde, chief of the NBS heat and power laboratories, initiated the new cryogenic laboratory. Under his design and direction, NBS cooperated with the Atomic Energy Commission in the project to provide facilities needed for the testing of cryogenic equipment.

Low temperature activities at Boulder fall to a staff of 60 NBS personnel under the supervision of R B Scott. Besides producing liquid hydrogen and nitrogen in unusually large quantities,

in 25 years....

2,228,460,000,000
cubic feet of air delivered!

without major mechanical difficulty of any kind

EVERY CLARAGE FAN
EVERY CLARAGE WASHER
STILL ON THE JOB!

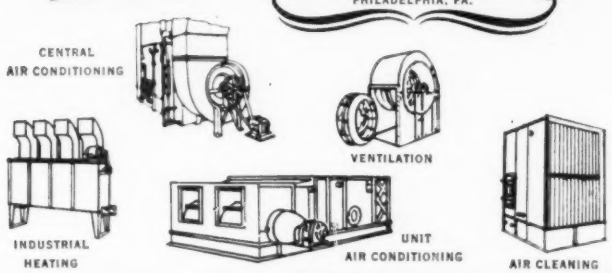
In June 1928, Fidelity-Philadelphia Trust Company, placed in operation its Clarage equipment —40 fans and 4 air washers.

Today the same 40 Clarage fans and the *same* 4 Clarage washers provide efficient, dependable ventilation for this great office building —and they are apparently good for another quarter-century of service.

In handling over two and one quarter trillion cubic feet of air, not a single replacement has been made, nor a single major mechanical difficulty encountered.

Thanks to adequate maintenance on the part of Fidelity management, this Clarage equipment has had the opportunity to prove our slogan: **"You can RELY on Clarage"—RELY on Clarage to cost you far less in the long run.**

Write us about your air handling and/or air conditioning needs...CLARAGE FAN COMPANY, Kalamazoo, Michigan.



You can Rely on...

CLARAGE

Headquarters for Air Handling and Conditioning Equipment

SALES ENGINEERING OFFICES IN ALL PRINCIPAL CITIES • *IN CANADA:* Canada Fans, Ltd., 4285 Richelieu St., Montreal

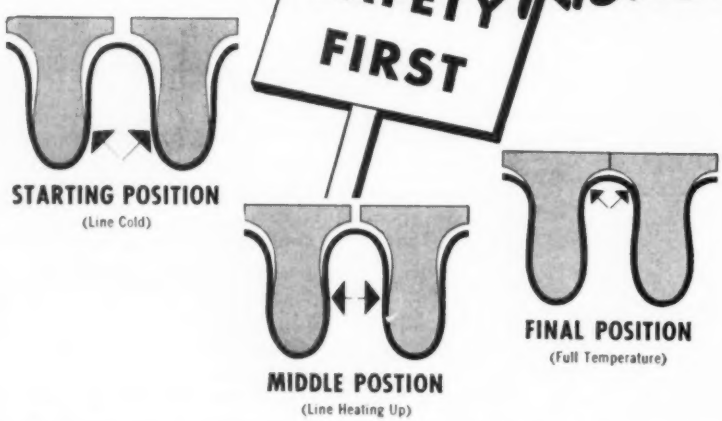
Badger *

DF-SE

EXPANSION JOINTS

The Joint that Doesn't Ask The Corrugation to Take

SAFETY FIRST Risks!



Call it conservatism on our part, if you like, but this whole matter of corrugation design involves an engineering safety factor that should be important to you when in the market for expansion joints. There's an economy factor, too.

We refer to the very definite relationship in the Badger Joint between the depth of the corrugation and the limit placed on the traverse for that depth. This is the safety factor. And since the traverse limit is consistent, it is a simple matter to select the size of joint that will give full traverse but need not be over-traversed. This is the economy factor. Our latest Bulletin gives full details of these important points.

Thus with the Badger Joint, you are protected against the danger of under-traverse and against uneconomical buying resulting from over-traversing. The Badger corrugation is never asked to do too much. Neither is there unusable excess traverse. With graduated corrugation depths, you can get a Badger Joint that will closely meet carefully calculated corrugation requirements for pipe size and anticipated traverse.

* Directed-Flexing, Self-Equalizing . . . exclusive with Expansion Joints designed and manufactured by . . .

BADGER MANUFACTURING COMPANY

Original and Sole Manufacturer of Badger Expansion Joints

230 BENT STREET • CAMBRIDGE • MASS.

More POWER NEWS

Begins on page 262

the new laboratory is pursuing a research program directed toward improvement of low-temperature equipment.

Present NBS-AEC aim is to find safer and more convenient means for handling liquid hydrogen and to increase existing knowledge concerning the changes in the properties of matter that occur at extremely low temperatures. Current data on tensile and impact behavior and fatigue properties of metals, alloys and plastics subjected to low-temperatures are very meager and confined mainly to problems in aircraft design.

As a first step toward the accumulation of thermal conductivity data, apparatus has been designed to provide test results in the range from 2 to 300 Kelvin. This new apparatus is expected to permit more rapid collection of data without loss of accuracy. NBS is also working on the design of more efficient insulated lines for transfer of liquid gases. A major part of this development covers valves, fittings and couplings that will permit easy assembly, extension and control of flow.

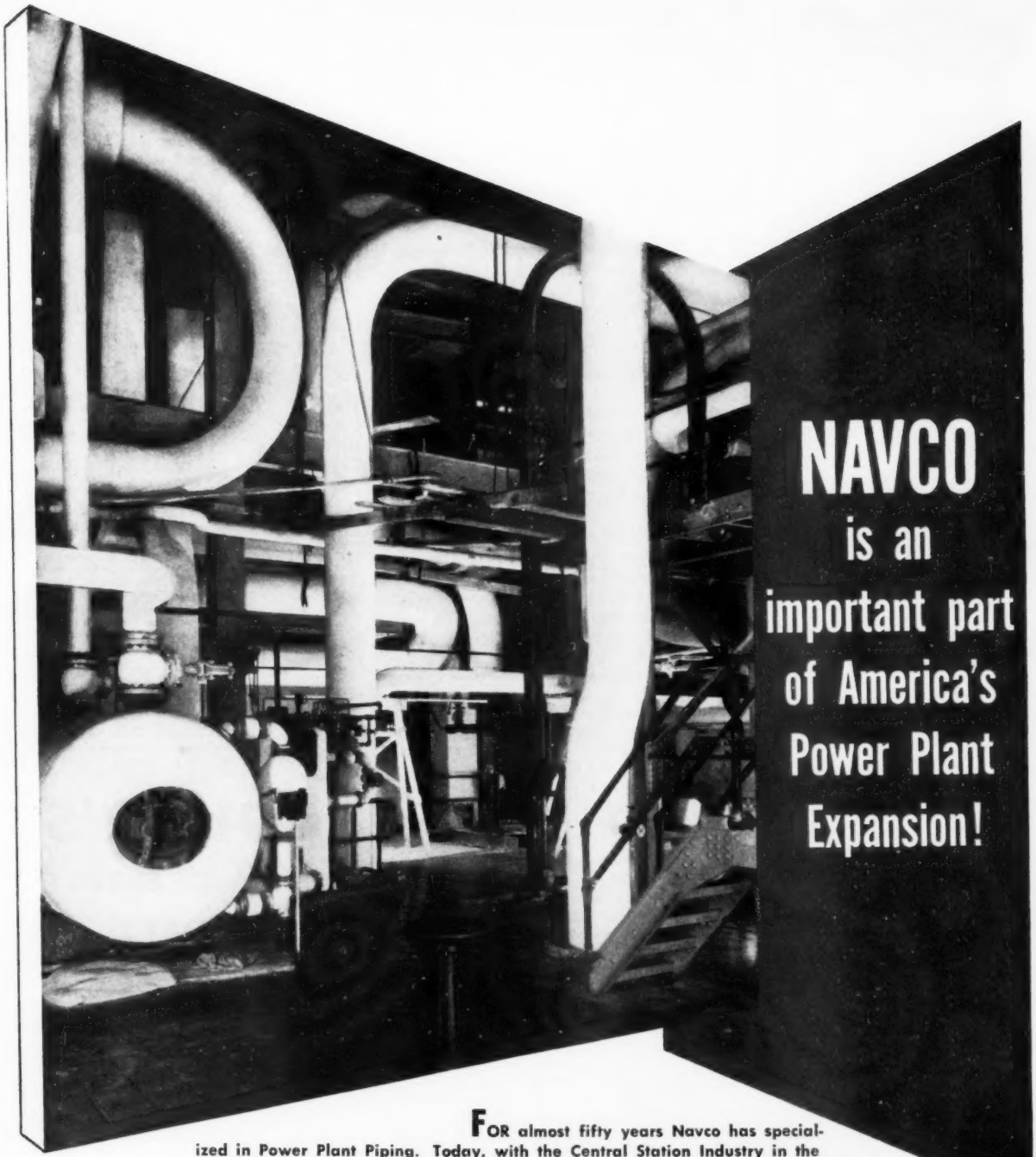
The Bureau's recent efforts to obtain liquid para-hydrogen have met with signal success. One of the liquefiers at the Cryogenic Laboratory has a special catalyzing chamber that produces almost pure liquid para-hydrogen. This liquid, free of exothermic ortho-para conversion, has excellent keeping qualities and can be stored with little loss for many days.

Here's Help for Program Chairmen

THE COMBUSTION CONFERENCE program of Bituminous Coal Research, Inc that met such widespread acceptance last year is being expanded to cover a wider range of subjects. Coal industry engineers with broad experience in combustion problems are now available to lead meetings on three topics: *The Use of Over-fire Jets for Smoke Reduction, Reducing Flue-Dust Emission from the Small Industrial Boiler Plant, and Mechanical Coal and Ash Handling for a Small Boiler Plant.*

In arranging these meetings, BCR supplies the speakers and handles publicity in advance of the meeting if requested. The speaker will use slides and models to present the information as graphically as possible. A portion of the meeting will be devoted to discussion of individual problems of those attending the meeting.

Groups of plant owners, engineering societies, air pollution control officials and coal companies will find it profitable to arrange such conferences in their city. Interested groups should con-



NAVCO is an important part of America's Power Plant Expansion!

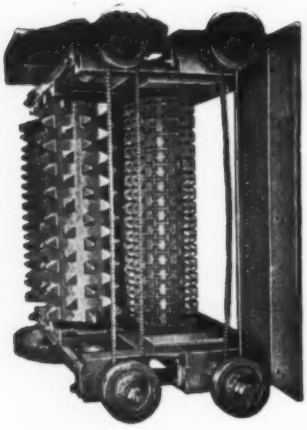
FOR almost fifty years Navco has specialized in Power Plant Piping. Today, with the Central Station Industry in the midst of an expansion program without precedent, Navco plays a very vital part of this growth. Navco offers the facilities of two complete fabricating plants, one of the most modern Piping Research Laboratories in the country and a large Construction Department manned by personnel experienced in all phases of High Temperature Power Plant Piping.

NAVCO

NAVCO PIPING

NATIONAL VALVE & MANUFACTURING COMPANY • PITTSBURGH, PA.

NEW YORK • CHICAGO • CLEVELAND • BOSTON • ATLANTA • BUFFALO • CINCINNATI



TWO STAGE — DOUBLE ADJUSTMENT

Crusher is pictured without hopper and sprocket guards, but is delivered complete.

WRITE TODAY FOR CRUSHER BULLETIN P-3

Two Stage CRUSHING IN ONE MACHINE!

The GUNDLACH "Two Stage" Coal Crusher incorporates two crushing stages in one machine and is designed to reduce RUN-OF-MINE to STOKER COAL in ONE operation. Compact design simplifies structural supports and installation. Rugged simple construction combined with engineering proved in the field makes this machine a profitable and reliable unit.

Fulfilling an urgent need in the industry, the GUNDLACH "Two Stage" Crusher has delivered over 85% uniform stoker coal from an Illinois mine run lot.

MATERIAL SIZE CAN BE CHANGED WHILE MACHINE IS RUNNING

All Gundlach Crushers are equipped with Gundlach Patented Crushing rollers. (Pat. No. 2578540)

T. J. GUNDLACH Machine Co., Belleville, Ill.

More POWER NEWS

Begins on page 264

tact the coordinator of the program, Charles H Marks, Bituminous Research, Inc, 980 Kinnear Rd, Columbus 8, Ohio.

American Petroleum Institute Withdraws Approval of Oil Tables

AMERICAN PETROLEUM INSTITUTE, in an action that will affect thousands of contracts, recently announced that it is withdrawing its approval of the National Standard Petroleum Oil Tables issued in 1936. The Institute said that the American Society for Testing Materials and the Institute of Petroleum have published a volume of recalculated and extended Petroleum Measurement Tables and that API is endorsing these as the new national standards.

The Executive Committee of the API Board of Directors voted approval of the change at a meeting in White Sulphur Springs, W. Va. The action came at this time to give the industry as much advance notice as possible for substitution of the tables in regulations, tariffs and contracts.

The Corps of Engineers has ordered new surveys of eight sites for multi-purpose dams on the middle Snake River basin. In directing the Walla Walla district office to undertake the studies, Maj Gen Samuel D Sturgis, chief of the corps, said Congress had provided $140,000 for the reports that are to be presented to Congressional committees next January.

Sites to be studied are Nez Perce and Mountain Sheep on the Snake; Crevice on the Salmon River; Kooskia, Forks and Penny Cliffs on the middle fork of the Clearwater River; Elkberry and Bruces Eddy on the north fork of the Clearwater.

In its 1950 survey of the Columbia basin, the Corps presented Nez Perce and Hells Canyon as jointly offering maximum storage benefits from the middle Snake; Crevice, the best adapted to development on the Salmon; the Kooskia, the best on the Clearwater system. All four have become involved in controversy aside from hydropower questions. Hells Canyon storage potential has stirred upriver irrigation advocates who foresee infringement water rights by power requirements; Crevice and Nez Perce, because these would create barriers against salmon runs to spawning grounds claimed by fish interests to be the finest in the Columbia's upper basin area; Kooskia, because it would flood four towns and 183 miles of roads in rugged Idaho mountains where route location is valued.

Some of the sites have been advocated as alternates to the controversial Hells Canyon dam spotlighted in recent FPC hearings on Idaho Power Co's proposal to build three low-head hydropower structures in the Snake basin in the near future.

Cut Fuel and Steam Costs with...

Babbitt
Adjustable
SPROCKET RIM
with Chain Guide

Plan your piping layout for most efficient and economical distribution of steam — place valves where they logically belong, without costly detours to bring overhead piping to floor level. Every overhead valve, wherever placed, is in easy reach with low-cost Babbitt Adjustable Sprocket Rim with Chain Guide. Save steam, fuel and other costs!

- Reduces piping costs
- Fits all valve wheels
- First cost is last cost

Range of 10 adjustable sizes fits all valve wheels from 2 to 30 inches diameter, with rising or non-rising stems. Only four simple, quickly-assembled parts.

Call your Industrial Distributor. He carries complete stocks. Or write for descriptive folder and prices.

Babbitt STEAM SPECIALTY CO.

2 BABBITT SQUARE, NEW BEDFORD, MASS.

POWER'S

"ATOMIC ENERGY TODAY"

—condenses the reports of four industry teams on actual plans and costs for atomic power plants.

—makes these reports understandable with a 4-page refresher course on nuclear fission.

This is what the busy engineer needs to know about atomic energy today.

16 pages. Profusely illustrated. 30¢ per copy. Less for quantity orders.

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Needs no jacket

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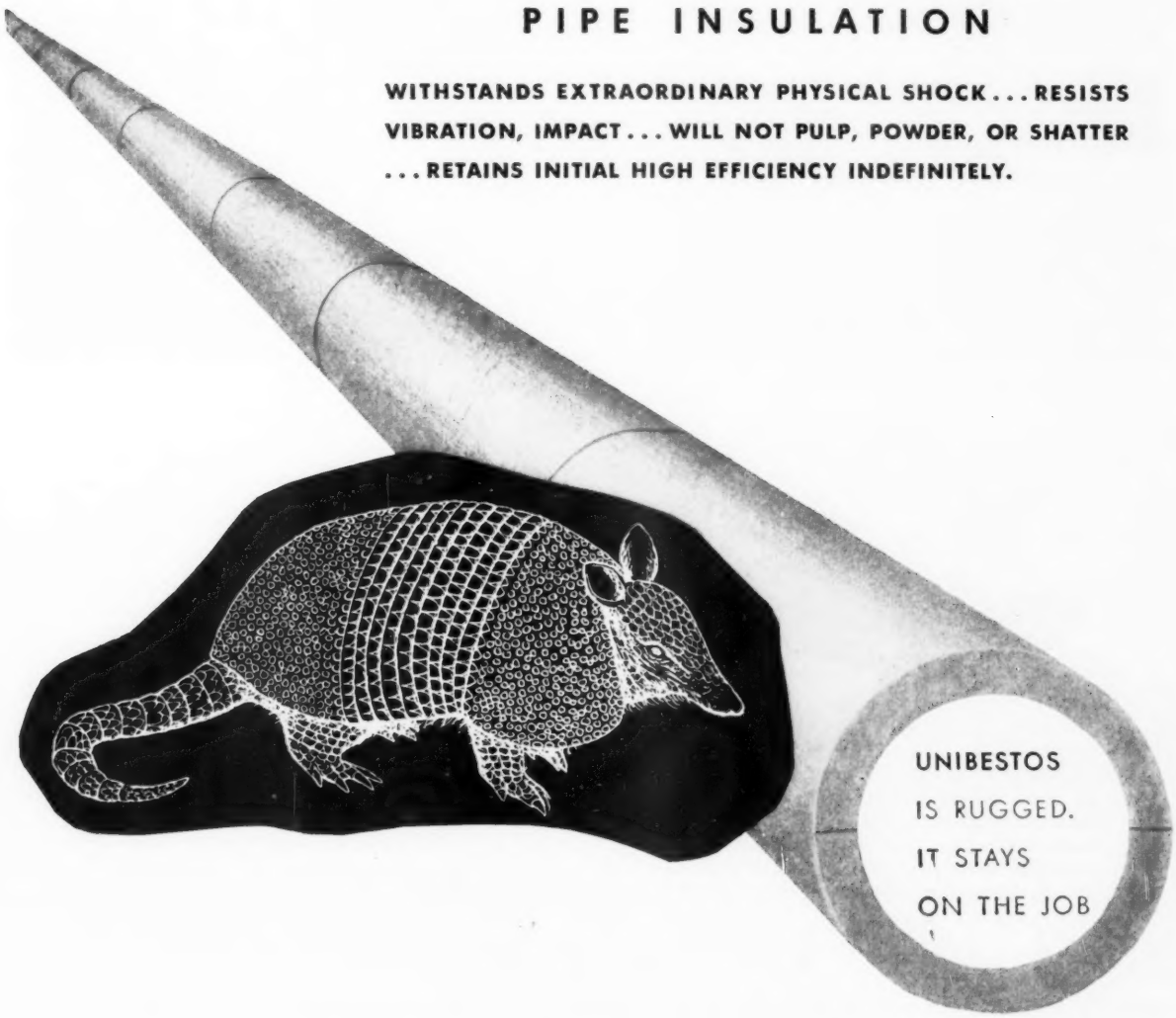
PIPE INSULATION

WITHSTANDS EXTRAORDINARY PHYSICAL SHOCK... RESISTS VIBRATION, IMPACT... WILL NOT PULP, POWDER, OR SHATTER ... RETAINS INITIAL HIGH EFFICIENCY INDEFINITELY.



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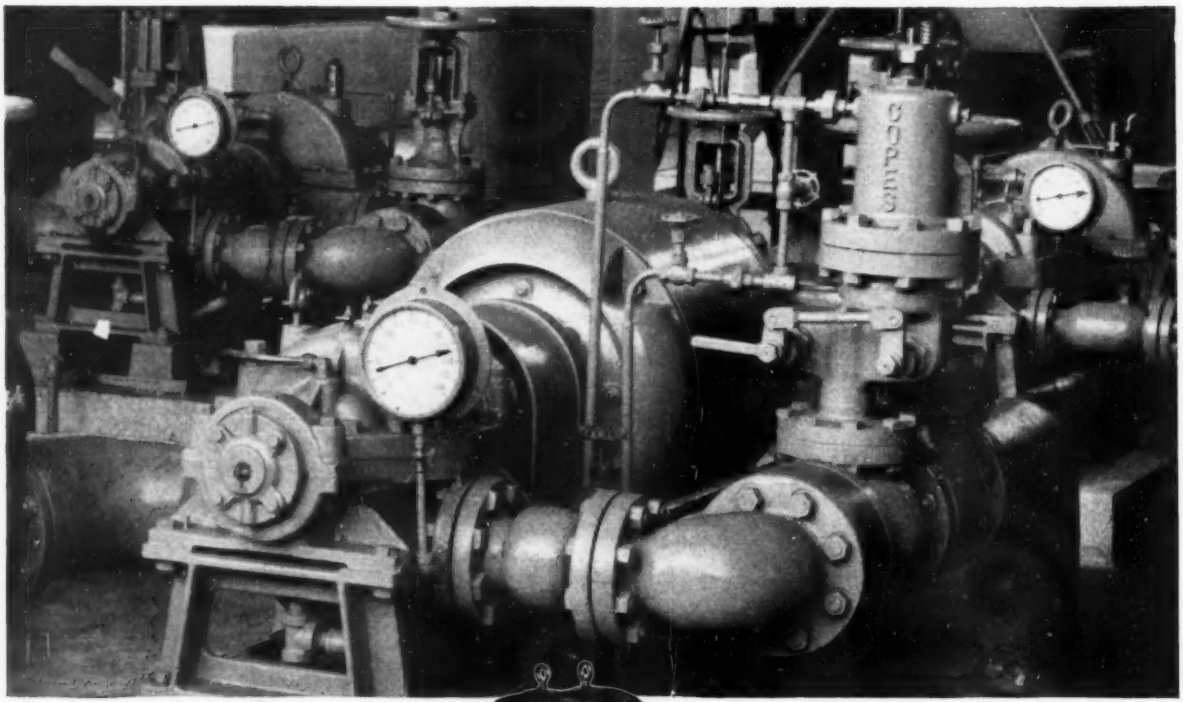
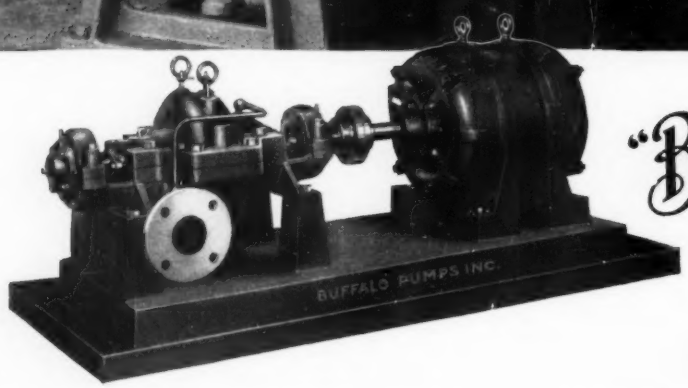
TOP PERFORMER UNDER PRESSURE!





"Buffalo"

TYPE "RR" for PUMP boiler feed service

In jobs such as boiler feed, where a pump is really "under pressure", the endurance and efficiency of "Buffalo" Type "RR" Pumps pay off, year after year. Built in 2- and 4-stage models for pressures as high as 500 pounds, these rugged pumps have efficient enclosed impellers, extra-deep stuffing boxes and heavy-duty ball bearings supporting both driven and driving ends of the oversize shafts. The extra-heavy casing has simply formed water passages and is horizontally divided on the centerline for accessibility. The stand and supports provide extreme rigidity. Why not have us mail you Bulletin 980-C for engineering details on these pumps that stand up under your toughest "pressure" jobs.

"Buffalo" BUFFALO PUMPS, INC.

488 BROADWAY BUFFALO, N. Y.

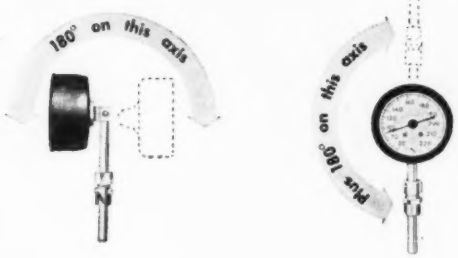
Subsidiary of Buffalo Forge Company

Canada Pumps, Ltd., Kitchener, Ont. Sales Representatives in all Principal Cities

A BETTER CENTRIFUGAL PUMP FOR EVERY LIQUID

Better ANY WAY YOU LOOK AT IT...

AMERICAN "*Every Angle*" DIAL THERMOMETER



The American "Every Angle" Dial Thermometer is easy to install and turn to any position for accurate face-to-face readings. Specify the "Every Angle" — indoor or outdoor design — and this unbeatable feature combination is yours:

DEPENDABLE ACCURACY. The "Every Angle" Thermometer is made of precision-machined, non-corrosive materials and operates by vapor pressure. It is precisely calibrated against certified standards to assure the most critical reading in the upper third of the dial, where the graduations are farthest apart.

CONVENIENCE. Dial face can be rotated 180° and tilted 180° for accurate reading at the most convenient angle.

WEATHER-PROOF DESIGN. *Screw-type ring* with tight-fitting gasket for weather-proof outdoor service; *slip ring* design for indoors.

REINFORCED MOUNTING. Heavy-gauge swivel hinge has a *stainless steel kingpin.* Reinforced connection between hinge and bulb. Greater strength and corrosion resistance, long service life!

EASY INSTALLATION. Socket connections have compression-type bushings. No costly jigs needed — connection easily welded to tanks or other irregular-shaped equipment.

Ask your Distributor to help you select the American "Every Angle" Dial Thermometers with the proper temperature ranges for your needs. Phone or write him today.

SPECIFICATIONS

NON-CORROSIVE DIAL CASE: Non-corrosive aluminum with smooth black finish. No protruding screw heads. Nickel-plated brass cup houses coiled capillary tubing.

DIAL: 3½" diameter. White with black figures. **POINTER:** Black, adjustable. **FRONT:** Heavy plate glass. **MOVEMENT:** Bronze or stainless steel. **BULB AND STEM:** Stainless steel. **SIZE CONNECTION:** ½", N.P.T. **STEM-LENGTHS:** 3", 5-5/16", 12", 18" and 24". **SEPARABLE SOCKETS:** Bronze, carbon steel or stainless steel.

STANDARD RANGES

Fahrenheit	
—60 to 20°	30 to 300°
—20 to 120°	100 to 300°
40 to 140°	90 to 350°
30 to 180°	190 to 390°
20 to 220°	260 to 450°
Centigrade	
0 to 100°	40 to 150°

YOUR INDUSTRIAL DISTRIBUTOR makes it his business to see that you get the best possible equipment. That's why he handles only products of proved quality and dependability — like Manning, Maxwell & Moore products.

AMERICAN INDUSTRIAL INSTRUMENTS

A product of **MANNING, MAXWELL & MOORE, INC.** STRATFORD, CONNECTICUT

MAKERS OF 'AMERICAN' INDUSTRIAL INSTRUMENTS, 'HANCOCK' VALVES, 'ASHCROFT' GAUGES, 'CONSOLIDATED' SAFETY AND RELIEF VALVES. BUILDERS OF "SHAW-BOX" CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES.

How ONE can equal SIX

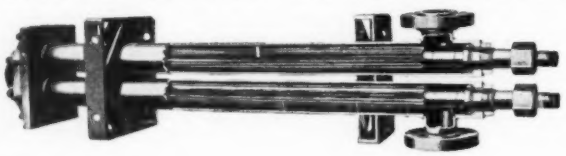
IN FUEL OIL HEATING

Conventional fuel oil heaters have bare tubes, with practically the same amount of surface inside and outside. But fuel oil requires more heat transfer surface than does the heating steam, because of its considerably lower heat transfer rate. Therefore, the number of bare tubes required for the heat-absorbing capacity of the oil is very much greater than the number which would be sufficient for the heat conductivity of the steam.

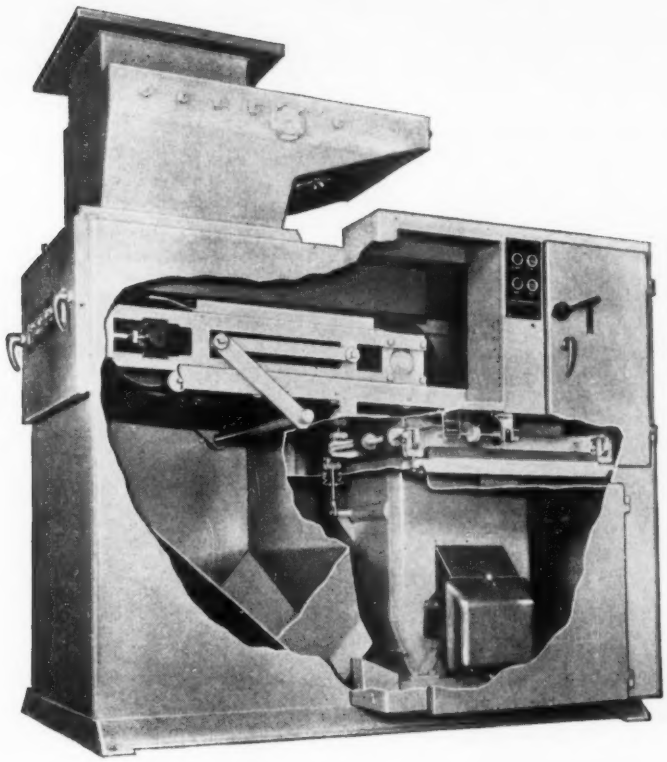
The G-Fin heat transfer elements of the G-R Twin G-Fin Section compensate for this difference in heat transfer rates of oil and steam. Their longitudinal fins have a total of more than 6 times as much surface as the interior of the elements. This means that a Twin G-Fin Section will have only 1/6 the number of tubes that would be required by a conventional bare tube heater for the same duty.

Investigate these compact, simple units and their many other advantages for heating your fuel oil. Complete information will be sent without obligation.

THE GRISCOM-RUSSELL CO., MASSILLON, OHIO



G-R HEAT TRANSFER APPARATUS *Twin G-Fin Section*



Maintenance Men Know the Inside Story

The unique design of the feeder frame, as shown below, provides an easy and quick means of changing an endless belt. This can be done without interrupting flow of coal to the boiler.

When maintenance men work with S-E-Co. Automatic Coal Scales, they know that they are working with equipment designed and built to give continuous service and which requires an absolute minimum of attention.

Maintenance men are well aware that the following time and trouble-saving features included in the S-E-Co. Coal Scale will mean better scale performance for your plant:

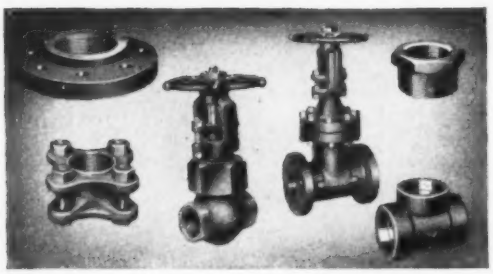
1. Neoprene rubber feeder belt that is molded endless — offering maximum in long life expectancy.
2. Rigid feeder frame, mounted on rollers, specifically designed for easy removal from scale body and quick changing of feeder belt. (See photograph to left.)
3. Electric counter with no linkage connections to get out of adjustment, cause errors, or need maintenance attention.
4. Large hinged and latched, dust-tight doors which facilitate maintenance by providing easy access to any part of the scale.
5. Electric circuits wired through terminal block, allowing easy check of any or all circuits at one point.

Write for Coal Scale Bulletin No. 61 or for our local representative to call and discuss the application of the S-E-Co. Coal Scale and related equipment to your particular plant problem.

STOCK EQUIPMENT COMPANY
745P HANNA BUILDING CLEVELAND, OHIO

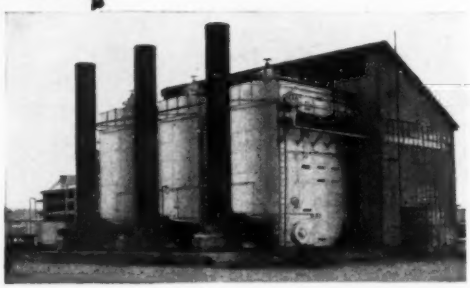
Specialists in Bunker to Pulverizer and Bunker to Stoker Equipment

Designed for today's *Tough* service demands



DROP FORGED VALVES AND FITTINGS FOR TOUGHNESS AND TROUBLE-FREE SERVICE

Drop forged from carbon and alloy steels, Vogt valves, fittings and flanges will safely handle liquids and gases at high pressures and high temperatures in power plants, chemical plants, petroleum refineries, etc. The complete line includes flanged, screwed and socket weld end globe, gate and check valves—ells, tees, and crosses—couplings—bushings—plugs—unions—flanges and flange unions—and welding heads.

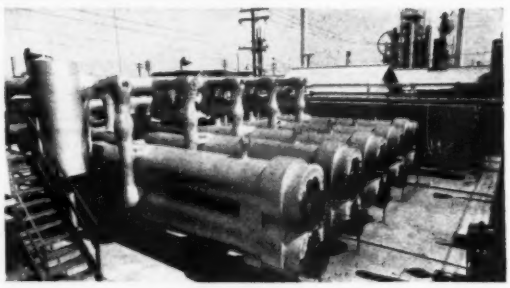


MODERN STEAM GENERATORS

Vogt steam generators are designed to give maximum rating in a minimum of space, with high efficiency and low maintenance expense. Bent tube types and straight tube, forged steel sectional header types to burn solid, liquid or gaseous fuels meet every power, process or heating requirement.

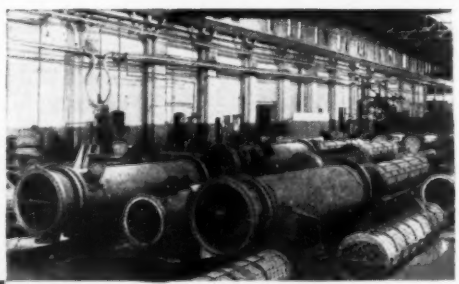
PROCESS EQUIPMENT FOR EVERY SERVICE

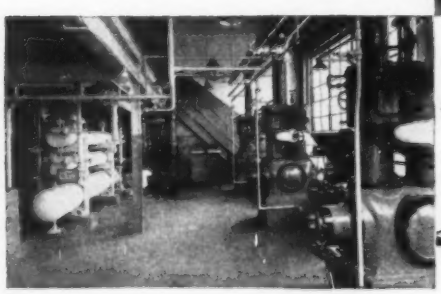
Vogt constructs process equipment in wide variety to all Codes. Stills and towers, oil chillers, crystallizers, heat exchangers, molding machines, etc., serve in the manufacture of oils, greases, 100 octane gasoline, synthetic rubber, chemicals and related products around the world.



SPECIAL MATERIALS COMBAT CORROSION AND PRODUCT CONTAMINATION

Our modern shops produce a wide variety of equipment from special metals and alloys to fight corrosion and product discoloration or contamination. Fabrication procedures insure that corrosion resistant properties of welds will match that of the materials used to construct the equipment.





MORE REFRIGERATION TONNAGE AT LESS COST

More than 70 years of engineering and manufacturing experience is incorporated in Vogt refrigerating and ice making equipment. Absorption Systems, Compression Systems, and Tube-Ice Machines in a wide range of capacities serve industrial and processing plants, and institutions, here and abroad.

Vogt

PRODUCTS

FOR REFINERIES, CHEMICAL PLANTS POWER PLANTS AND PROCESS INDUSTRIES

HENRY VOGT MACHINE CO.
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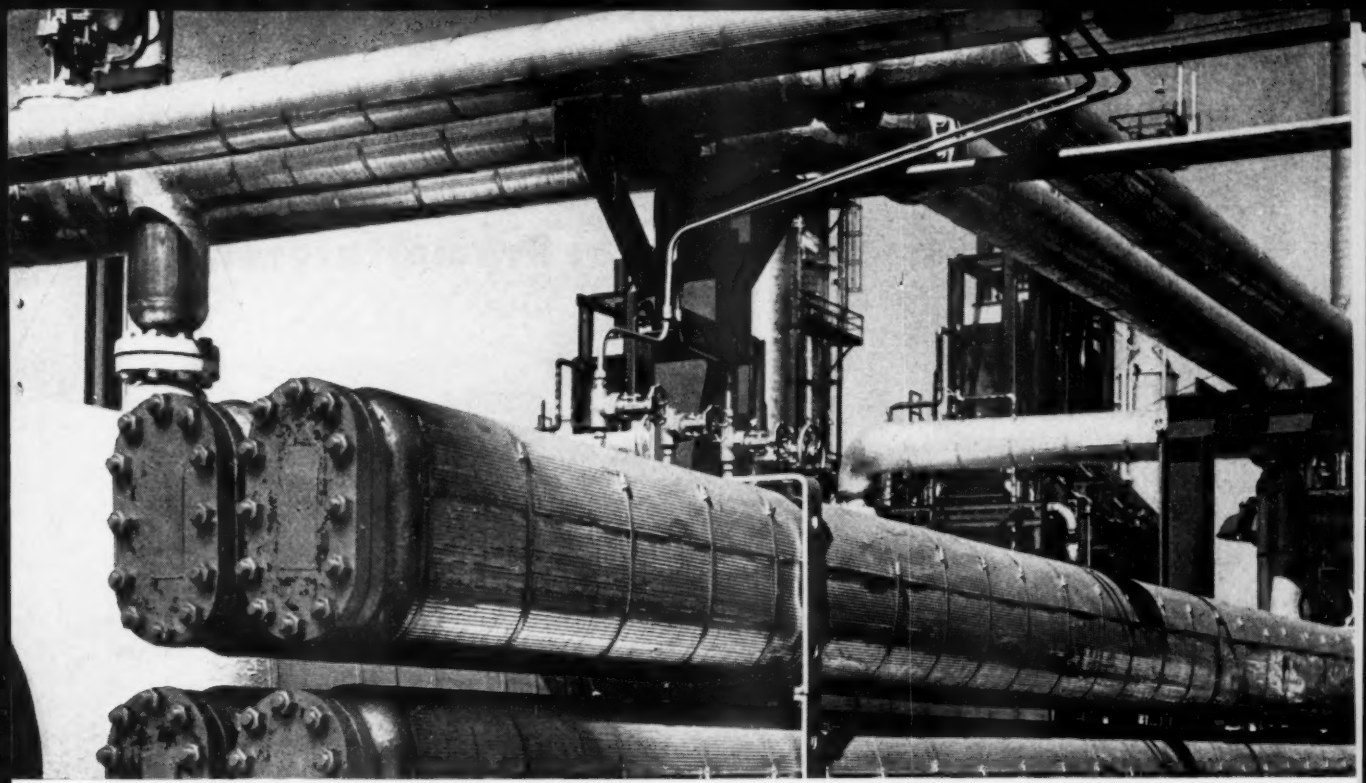


This new kind of aluminum jacketing is used in more and more outdoor processing plants to protect insulated towers, vessels, lines—it eliminates costly maintenance and replacement of old-fashioned coverings. Engineers report that Childers Jacketing has advantages not found in expensive heavy sheet aluminum, costs less to buy, far less to apply.

New Aluminum Jacketing Protects Insulated Lines...Cuts Costs 28%

How 986 of America's Leading Companies Saved Money By Weather-proofing Insulated Lines This New Way:

A two-man crew can apply the jacketing fastest. Only tools are a pair of pliers and a wedge or screw driver as shown here. Note how easily the jacketing forms around the pipe.

Aluminum strapping can be pulled plenty tight enough with just pliers like this. No special strapping tool needed. Strapping is pulled down between lugs and bent over.

Up-to-date appearance, low cost, and long life go hand in hand in a new aluminum jacketing for insulated lines. Developed by Childers Manufacturing Co., Houston, Texas, it is the first permanent weather-proofing that offers both low initial cost and low application cost.

Childers Jacketing, made of tough 3S aluminum alloy for maximum corrosion resistance, lasts years without painting or other maintenance. It costs less than even the cheapest kind of weather-proofing, when the cost of one paint job is considered. Savings run up to 28%.

Cost-minded engineers are also impressed with the gleaming beauty of Childers Jacketing that means "good plant housekeeping."

Available with moisture barrier attached, for use over 85% magnesia insulation.

5 years of tests and major installations in 986 of America's leading processing plants, refineries, and power plants have proven the advantages of Childers Aluminum Jacketing over other types.

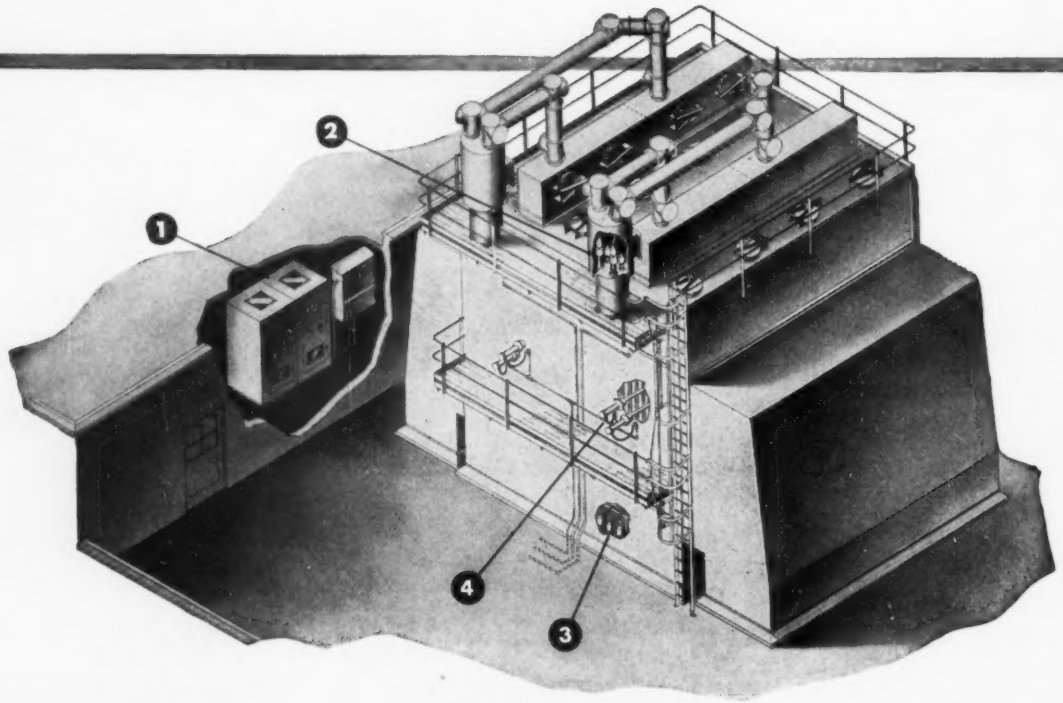
Try this low-cost protection in your plant. Write today for engineering data and information about how you can order a 400 sq. ft. roll to test on one of your insulated lines. No obligation.

Address Childers Manufacturing Co., Dept. PO-6, 3620 W. 11th St., Houston 8, Texas.

Engineering representatives in all principal cities to work with you on your problems.

This is how the flexible, easy-to-handle Childers Jacketing arrives at the job site. It is in convenient rolls 4 feet wide and 100 feet long—just right for one man to handle—and is available either with or without a moisture barrier attached on the back of the .006" aluminum "skin." It can be cut to proper lengths using any flat table and a straight-edge. (Advertisement)

What's New in Electrical Precipitators?



FEATURES:	RESULTS:
1. Remote Control—Entire installation is operated by switchboard control from any convenient location.	**1.** Central control room operator can see all meters and operate all controls that determine optimum performance.
2. Low-cost Energization—Weatherproof high voltage transformer and electronic tube rectification equipment allow location flexibility and minimum power consumption.	**2.** Space conservation, short high voltage connection between rectifiers and precipitators insure compact, economical installation.
3. Unique Electrode Design—Plumb-bob discharge electrodes, individually weighted to remain taut, are uniformly positioned by a lower framework.	**3.** Discharge wires are kept perfectly aligned at all times for maximum overall precipitator performance.
4. Electronically Controlled Rapping—New magnetic impulse rappers are designed for continuous, sequential, smoothly regulated electrode rapping.	**4.** Eliminates stack puffs and produces increased overall efficiency.

Ask your Research Corporation representative to bring you up to date on the details of these and many other improvements that you will find in the modern Cottrell Electrical Precipitator.

RESEARCH CORPORATION

405 Lexington Avenue, New York 17, N. Y.
Bound Brook, N. J. • Grant Building, Pittsburgh 19, Pa.
122 South Michigan Avenue, Chicago 3, Ill.

RC1D

IT TAKES *SMALL* PIPING, TOO

to produce BIG STEAM!

IT PAYS TO GIVE *Pittsburgh Piping*

THE COMPLETE PIPING JOB

Piping for high-temperature, high-pressure stations is not all big, massive mains. Blowdown lines . . . even air lines carrying only about 100 psi are all parts of a chain—the links of which must be forged with equal skill.

Every engineer knows his biggest headaches are caused by "small" troubles. That's why, at P. P. & E., "little things" get great attention.

We test the molecular structure of weldments with the eagle eye of gamma rays . . . search for flaws with ultra-sonic sound . . . control annealing temperatures electronically—finally, install every part of a piping system, no matter how small, with the same degree of precision.

The end result is greater safety, higher efficiency, and longer service from a P. P. & E. installation.

Pittsburgh Piping

AND EQUIPMENT COMPANY

10 Forty-Third Street—Pittsburgh, Penna.

Atlanta . . . . . Whitehead Building	Houston . . Heights State Bank Bldg.
Boston . . . . . 10 High Street	New Orleans . . . . . P. O. Box 74
Chicago . . . . Peoples Gas Building	New York . . . Woolworth Building
Cleveland . . Public Square Building	San Francisco . . 785 Market Street

Accurate Measurement of

HIGH DIFFERENTIAL PRESSURES

...at high statics!

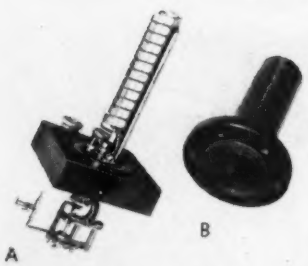
Differential pressure measurements at ranges far above the limits of conventional devices, and at statics up to 2200 psig, can be readily recorded and controlled by the new Foxboro Type EH Instrument.

Many large steam generating plants have installed Type EH Instruments to control differential pressure across boiler feed valves, thus assuring at all times that the boiler feed pump is operating at pressures high enough above boiler pressure to assure safe operation.

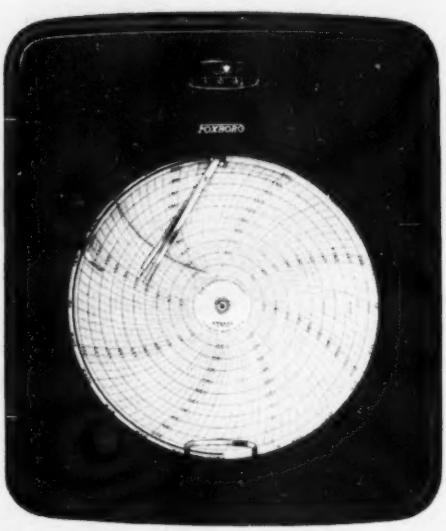
Major chemical companies have employed this instrument to measure pressure loss across fixed catalyst beds. By operating until a pre-determined pressure loss indicates catalyst exhaustion, instead of shutting down and regenerating on a time cycle, they have increased production, cut costs.

Differential pressure ranges are available from 0-100 psig minimum to 0-2200 psig maximum. Design of the helical actuating element assures precision over the entire measuring span. Heavy-duty construction of the element and its housing makes operation safe.

Write for details on Foxboro Type EH Instruments for indicating, recording, controlling, transmitting.



Heart of the Foxboro Type EH Differential Pressure Controller (below) is the heavy-duty stainless steel helical measuring element (A) with its alloy-steel housing (B). This assembly is mounted at rear of instrument case, the motion of the helical being transmitted to the instrument mechanism through a friction-free pressure seal bearing.

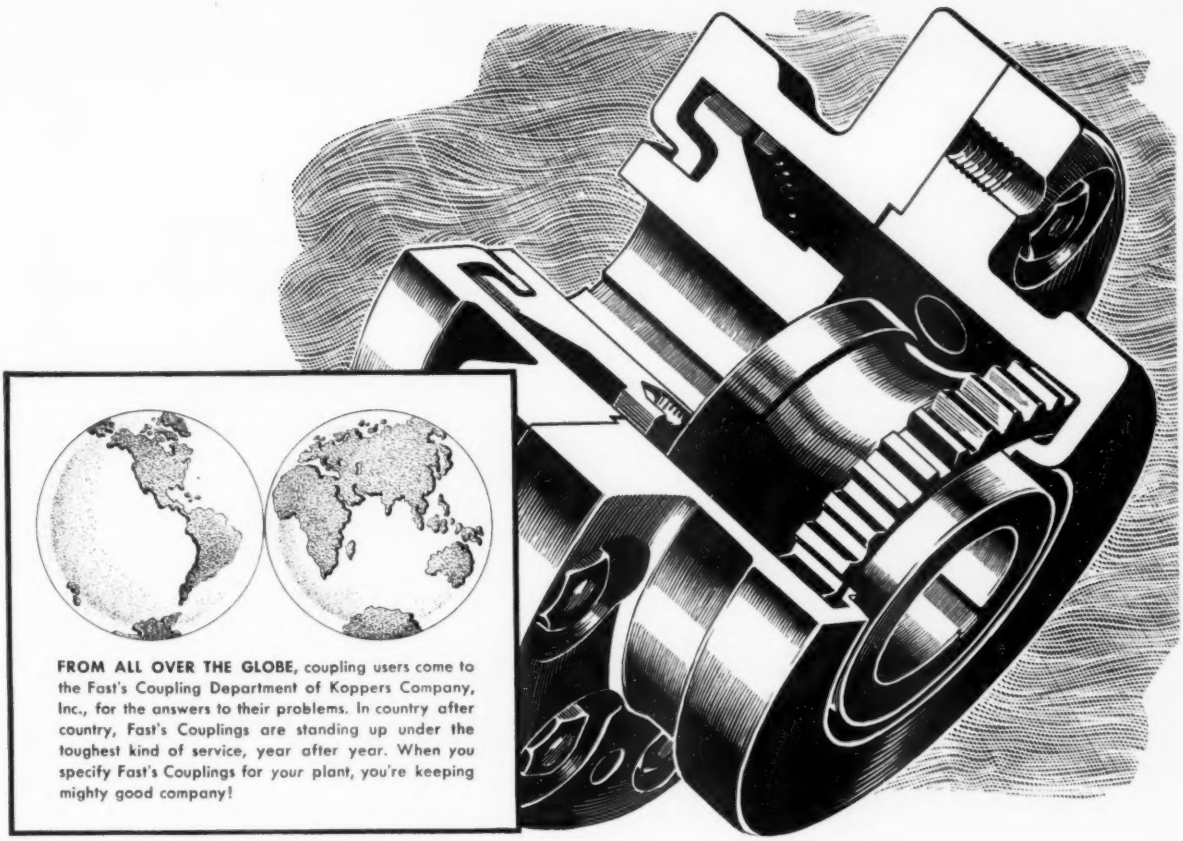


THE FOXBORO COMPANY, 6811 NEPONSET AVE., FOXBORO, MASS., U.S.A.

FOXBORO
REG. U. S. PAT. OFF.

PRESSURE INSTRUMENTS

FACTORIES IN THE UNITED STATES, CANADA, AND ENGLAND



FROM ALL OVER THE GLOBE, coupling users come to the Fast's Coupling Department of Koppers Company, Inc., for the answers to their problems. In country after country, Fast's Couplings are standing up under the toughest kind of service, year after year. When you specify Fast's Couplings for *your* plant, you're keeping mighty good company!

In world-wide reputation for rugged dependability . . .

FAST'S Couplings are FIRST!

Fast's Couplings are still first choice the world over . . . with their number pushing the three-quarter million mark!

Whatever your coupling applications, this reputation is your guarantee of proved protection against costly shutdowns! Fast's Couplings give you *rugged construction* . . . because their original design has been maintained without basic change or sacrifice in size or materials. Fast's Couplings give you *lowest cost per year* . . . because they usually outlast the equipment they connect. And Fast's Couplings give you the benefit of Koppers *free* engineering service . . . assuring you of the right coupling for any job and the right solutions to tough coupling problems.

Write today for full details on Fast's Couplings and Koppers Engineering Service to: KOPPERS COMPANY, INC., *Fast's Coupling Dept.,* 321 Scott Street., Baltimore 3, Maryland.

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THE ORIGINAL

FAST'S Couplings

METAL PRODUCTS DIVISION • KOPPERS COMPANY, INC. • BALTIMORE, MD. This Koppers Division also supplies industry with American Hammered Industrial Piston and Sealing Rings, Koppers-Elex Electrostatic Precipitators, Aeromaster Fans and Gas Apparatus.

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KOPPERS COMPANY, INC., *Fast's Coupling Dept.,* **321 Scott St., Baltimore 3, Md.**

Gentlemen: Send me a Fast's Catalog giving detailed descriptions, engineering drawings, capacity tables and photographs.

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City ..... **Zone** ..... **State** .....

You're sure of UNIFORM HIGH QUALITY

SEAMLESS • PRESSURE • MECHANICAL

CARBON STEEL TUBES

when you specify GLOBE

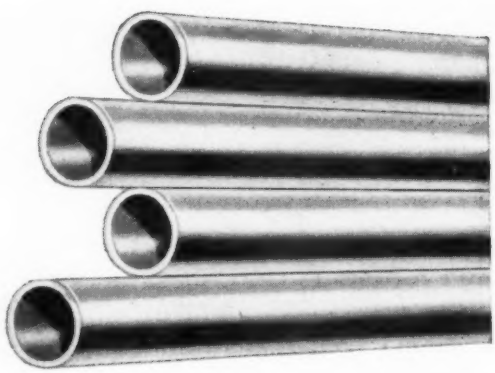
SIZE RANGE — WALL THICKNESS

Globe seamless carbon steel tubes are available in a size range of ½ inch to 7½ inches O.D.; wall thickness of .028 to 1.000 inch.

APPLICATIONS

Globe Pressure Tubes are used for boilers, condensers, heat exchangers and process equipment. They meet most exacting demands of modern high pressure and high temperature installations. Globe Mechanical Tubing (seamless) is produced by piercing solid billets. It is an ideal material for low-bearing structural members and parts where strength with minimum weight is needed. Its economy for the manufacturing of many machine parts is universally recognized.

Globe seamless carbon steel tubes are furnished to standard specifications in low and medium carbon ranges.



WHEN you specify Globe you are sure of uniform high quality carbon steel tubes. That's because they are the product of highly developed production facilities and specialized quality controls and methods.

Globe engineers are at your service to assist in the selection of tubing of the exact characteristics you require.

GLOBE TUBES

GLOBE

STEEL TUBES CO.

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Chicago • Cleveland • Philadelphia • St. Louis • New York • Detroit • Denver • Houston • San Francisco
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Producers of Globe seamless stainless steel tubes — Gloweld welded stainless steel tubes — alloy-carbon seamless steel tubes — Globeiron (high purity ingot-iron) seamless tubes — Globe welding fittings.

EAGLE-PICHER

One-Cote Cement

INSULATES PROTECTS FINISHES

in one quick application

EAGLE-PICHER
ONE-COTE CEMENT
An all-purpose, fast setting finishing cement that insulates as well as protects
50 lbs. Net Weight

ONE APPLICATION saves valuable man-hours! Whether equipment is hot or cold (above 32 F), your crew simply trowels on the white, clean-handling cement to get a smooth, light-reflectent insulating surface.

ONE APPLICATION assures high thermal efficiency at temperatures up to 1000 F. One-Cote Cement sets quickly—and when installed indoors requires no finishing treatment. In outdoor installation, a weather-protective coating is recommended.

For a cement that INSULATES—PROTECTS—FINISHES in one application, you owe yourself a thorough investigation of Eagle-Picher One-Cote. For example, one of the many plus advantages you will value is its rust-inhibitive quality—it actually protects your valuable equipment. Get *all* the facts, today!

RECOMMENDED APPLICATIONS *Valves and fittings • storage tanks • digesters • breechings • glass and ceramic kilns • stills • ovens • steam cylinders • air preheaters • hot air ducts • turbines • piping*

Since 1843

EAGLE EP PICHER

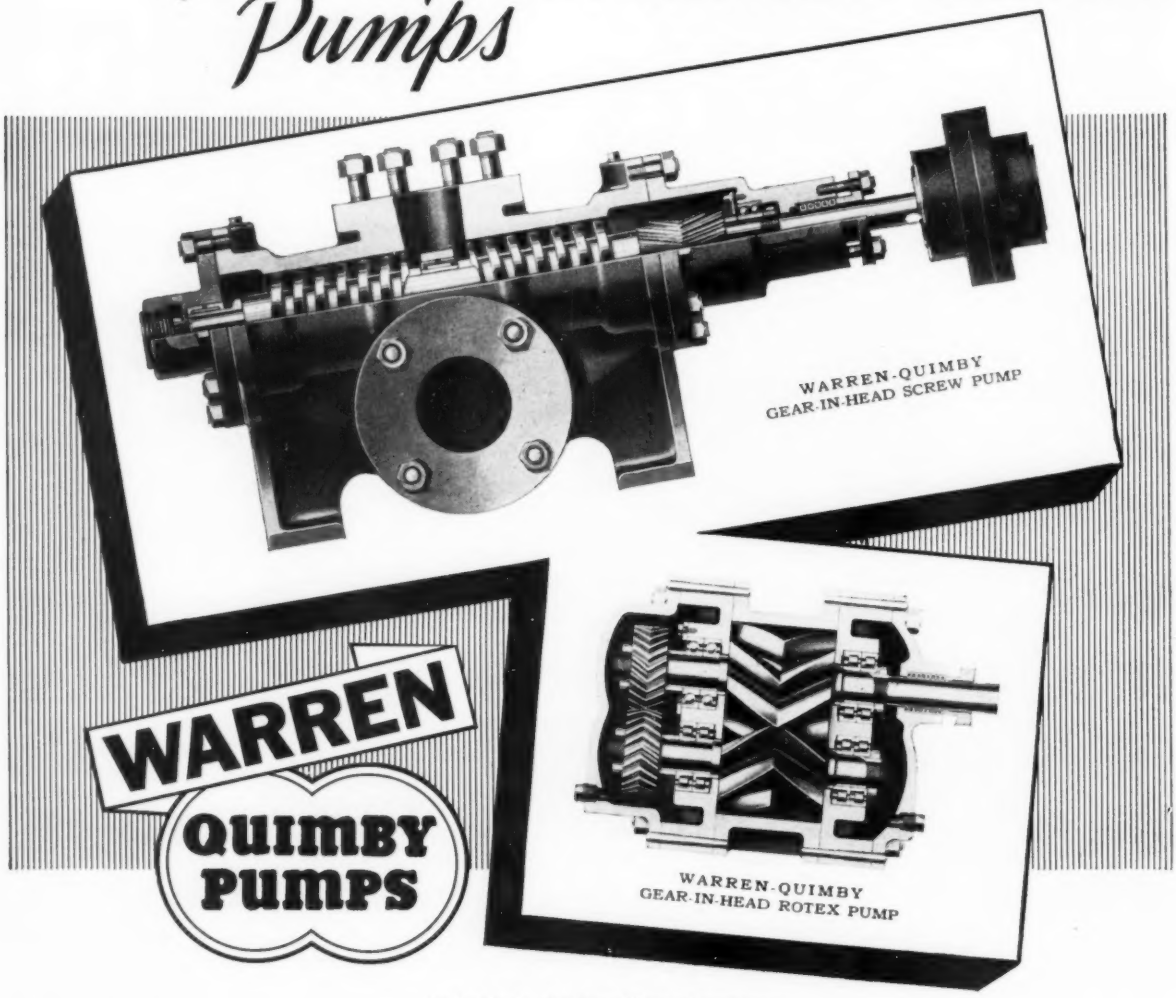
THE EAGLE-PICHER COMPANY

General Offices: Cincinnati (1), Ohio

For greater efficiency, protection and economy, specify these Eagle-Picher products:
Insulating Felts • Insulating Block • Blankets • Loose Wool • Mineral Wool Pipe Covering • Stalastic Stamastic • Insulseal • Finishing Cements • Insulating Cements • Swetchek • Insul-Stic • Fireproofing Cement

Member of Industrial Mineral Fiber Institute

NOW *Quimby Pumps* WITH WARREN SERVICE

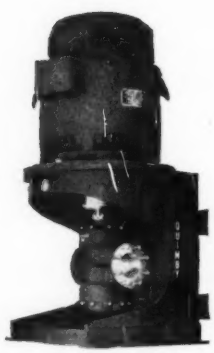


Now you can look to Warren for Screw and Rotary pumps as well as Centrifugal and Reciprocating types.

Quimby built the first balanced quadruplicate screw pump in 1893. The salient design feature of separate screws and timed driving gears have never been changed. However, refinements through the years have widened the scope of applications to include the handling of any non-abrasive liquid or semi-liquid at moderate and high pressures.

The "Rotex" is a superior rotary pump of unique construction that has numerous applications where moderate pressures are involved.

These new members round out the Warren family and we invite your inquiries on any problem involving Screw and Rotary, Centrifugal or Reciprocating Pumps.

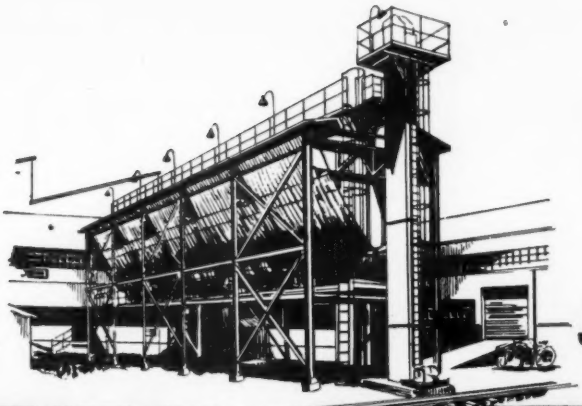


Both Screw and Rotex type pumps are available either horizontal or vertical mounted.

PQ-2

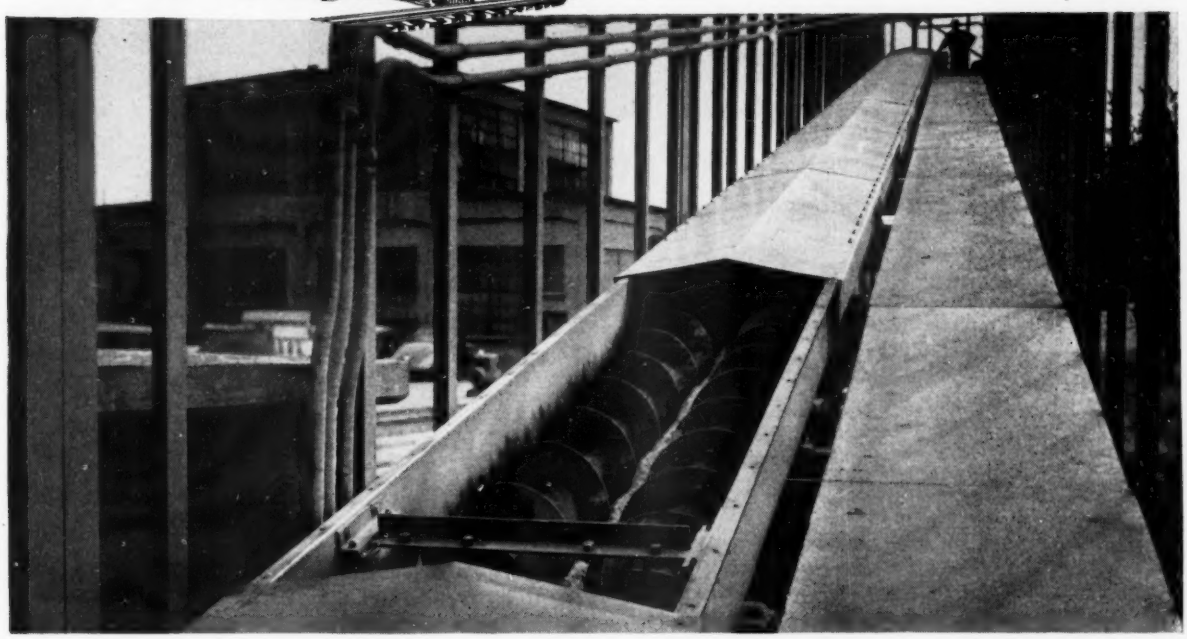
WARREN PUMPS

WARREN STEAM PUMP COMPANY, INC., WARREN, MASSACHUSETTS



VERSATILE...

is the word for JEFFREY standard units



Line drawing: Jeffrey Standard Bucket Elevator feeding storage bin.

Photo: Jeffrey Twin-Spiral Conveyor System handling finished cement from mill to railroad cars for bulk shipment.

OTHER JEFFREY STANDARD UNITS
BELT CONVEYORS
APRON CONVEYORS
SCRAPER CONVEYORS
POWER SCOOPS

Jeffrey Standard Spiral Conveyors and Bucket Elevators are available in a range of types and sizes that meet practically every industrial requirement and operating condition.

Each Spiral Conveyor is completely assembled in our plant to assure perfect fit and alignment. Before dismantling for shipment, parts are match-marked to facilitate field erection.

Split-head Sections are available on Jeffrey Standard Bucket Elevators. New High-Front Buckets on continuous types increase the versatility of the line.

WRITE FOR CATALOGS CONTAINING COMPLETE INFORMATION.

THE JEFFREY MANUFACTURING CO.

ESTABLISHED 1877

Columbus 16, Ohio

sales offices and distributors in principal cities

PLANTS IN CANADA, ENGLAND, SOUTH AFRICA

IF IT'S MINED, PROCESSED OR MOVED
. . .IT'S A JOB FOR JEFFREY!

SLEEVOIL

—the super-quality fan bearing for mechanized draft installations!

● Hundreds of generating plants in America run on Dodge Sleevoil Bearings. These famous bearings combine quietness, long life and dependability to a degree unique in the bearing field. They offer engineers of costly power plants a priceless safeguard for their equipment.

Sleevoil Bearings are a Dodge development—created especially to meet the exacting requirements of fan and blower service. They are ideal bearings for important installations calling for induced or forced draft. Designed in cooperation with engineers of leading fan and blower manufacturers, they have a long record of dependable performance in critical service.

Dodge Sleevoil Pillow Blocks are normally available from stock—in both plain and water-cooled types, in shaft sizes from 1-7/16" to 8". Write us for information.

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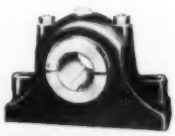
DODGE
of Mishawaka, Ind.

CALL THE TRANSMISSIONEER, your local Dodge Distributor. Factory trained by Dodge, he can give you valuable assistance on *modern* power transmission machinery for *modern* installations. Look for his name under "Power Transmission Equipment" in your local classified phone book.

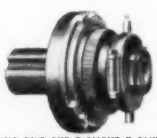
FIRST IN POWER TRANSMISSION MACHINERY!

SEALED-LIFE V-BELTS; TAPER-LOCK SHEAVES

TORQUE-ARM SPEED REDUCERS



DODGE-TIMKEN PILLOW BLOCKS



ROLLING GRIP AND DIAMOND D CLUTCHES

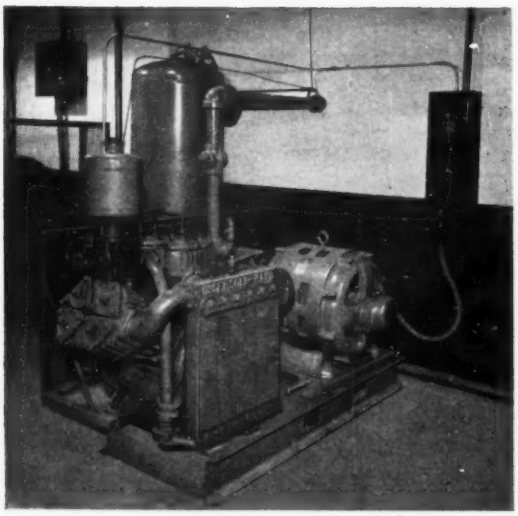
NAME PLATES

FOR YOUR NAME PLATE REQUIREMENTS, WRITE OUR SUBSIDIARY,
CHICAGO THRIFT-ETCHING CORPORATION, 1555 SHEFFIELD AVENUE, CHICAGO 22, ILLINOIS

from 1/2 to 100 hp

I-R AIR-COOLED COMPRESSORS

give you these important advantages

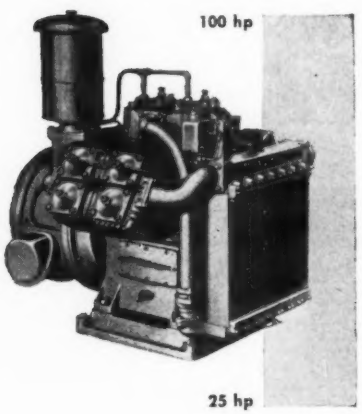


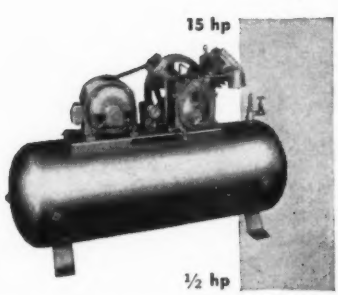
This 50-horsepower V-belt driven Type 40 compressor supplies air in an abrasive-manufacturing plant.

- **SMALL FLOOR SPACE**
- **NO SPECIAL FOUNDATION**
- **EASY MOVABILITY**
- **NO COOLING WATER REQUIRED**
- **NO WATER PIPING**
- **NO DANGER OF FREEZING**

● Wherever compactness and light weight, low installation and operating costs, dependable service, and minimum attendance are important factors, Ingersoll-Rand air-cooled compressors fill all the requirements.

Their wide acceptance by all types of industry—from mines to power plants—from drug manufacturers to cargo ships—proves their versatility and dependability. For main air supply, for supplementing the capacity of larger compressors or for de-centralized air systems, Type 30 and Type 40 compressors are ideal. Your nearest I-R representative will be happy to apply his knowledge and experience to your particular problem.





790-1

Type 40 Compressors are two-stage, air-cooled . . . sizes from 25 to 100 hp. Discharge pressures from 80 to 125 psi, also up to 200 psi. . . . Three types of drive: "Motor-compressor," with built-in electric motor; flexible coupled; or V-belt driven. Durable, efficient Channel Valves, Timken tapered-roller main bearings and Constant-level lubrication are additional features. Dual-Control permits selection of constant speed or automatic-start-and-stop control.

Type 30 Compressors come in sizes from ½ to 15 hp . . . handle smaller volumes of air at pressures from 5 to 3500 psi. Available as complete receiver mounted units, with base-plate mountings, or as bare compressor units. Can be equipped with automatic-start-and-stop control, constant-speed control, or dual-control to permit selection of either type. For special service such as instrument control or agitation, certain sizes are available with non-lubricated cylinders.

Ingersoll-Rand

11 Broadway, New York 4, N. Y.

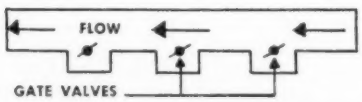
PUMPS • CONDENSERS • AIR AND ELECTRIC TOOLS • ROCK DRILLS

CANTON STOKERS

flo-tubes

WHEN COAL GOES UP THIS WAY . . . LABOR COSTS COME DOWN

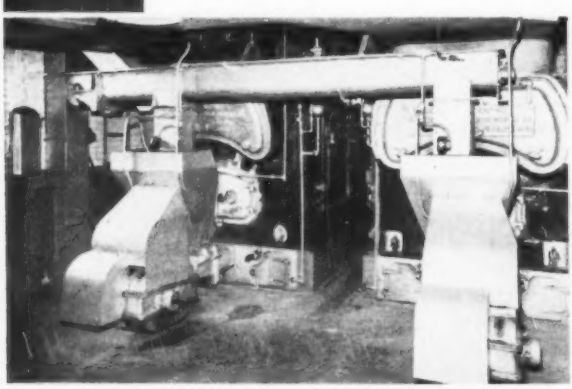
Rising costs, going higher, have speeded up the need for automatic handling of coal —the lowest priced fuel. It will pay to look into the new developments by Canton Stoker, specialists in COAL FIRING, HANDLING, and CONTROL equipment.



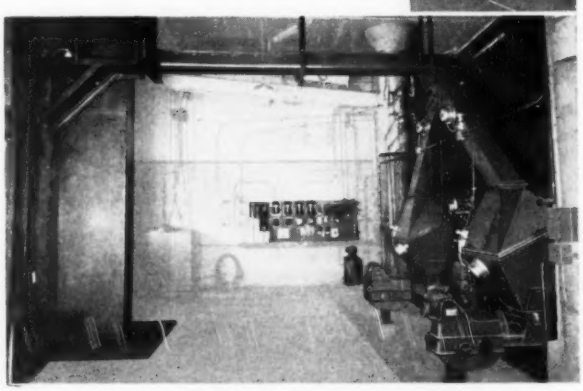
FEEDING THREE OR MORE HOPPERS: The horizontal crossfeed unit is designed to convey coal to a battery of hoppers; receives its fuel by transfer from any type of inclined or vertical Conveyor.

FEEDING ONE OR TWO HOPPERS: This design conveys coal from the coal bin or pile on an inclined plane to feed one hopper or with 'Y' assembly to feed two hoppers.

CANTON "FLO-TUBE" COAL CONVEYOR SET UP ON FACTORY TEST FLOOR BEFORE SHIPMENT, SHOWING APPLICATION TO CANTON STOKERS DESIGNED FOR PACKAGE TYPE WATER TUBE BOILERS. THIS IDEAL INSTALLATION INCLUDED CANTON SYNCHRONIZED COMBUSTION CONTROL, CANTON "TURBO-AIRE" SMOKE CONTROL, TWO CANTON LO-SET RAMFEED STOKERS HOPPER FILLED BY CANTON FLO-TUBE FROM COAL BIN. STARTS AUTOMATICALLY AT LOW COAL LEVEL IN HOPPER . . . FILLS BOTH HOPPERS UNTIL DESIRED HIGH LEVEL IN HOPPERS IS REACHED.



INSTALLATION AT A LARGE BAKERY IN PENNSYLVANIA. CANTON LO-SET RAMFEED STOKERS FOR ANTHRACITE COAL INSTALLED UNDER STEEL FIREBOX POWER BOILERS, INCLUDING BIN-TO-HOPPER COAL CONVEYOR AUTOMATICALLY CONTROLLED, PLUS CANTON COMBUSTION CONTROLS.



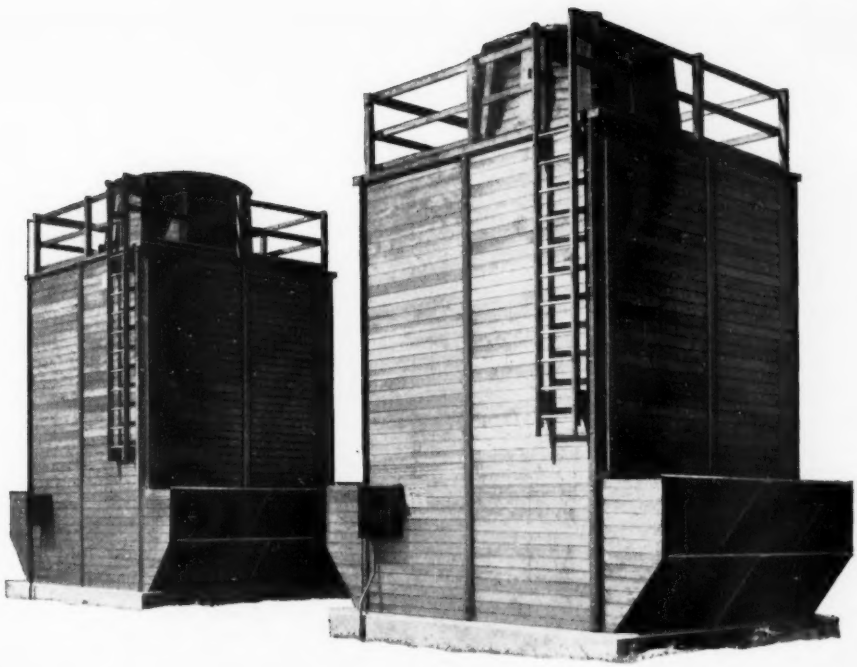
THIS EFFICIENT LAYOUT FEATURING CANTON STOKERS AMPLY FULFILLS EVERY HEAT AND POWER DEMAND OF A HUGE FURNITURE WAREHOUSE AND SALESROOM IN MICHIGAN. COAL ELEVATOR AT LEFT, FLO-TUBE DIRECTLY OVERHEAD.

CANTON STOKERS

CANTON STOKER CORPORATION

741 ANDREW PLACE S. W. • CANTON, OHIO

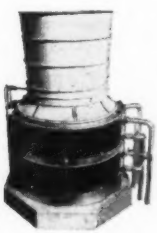
REPRESENTATIVES IN PRINCIPAL CITIES — OR WRITE DIRECT FOR COMPLETE INFORMATION ON: **FLO-TUBE SYSTEMS; BINFEED STOKERS; TURBO-AIRE SMOKE CONTROLS AND ALL MODELS OF CANTON STOKERS.**



MORE EFFICIENCY MEANS MORE POWER

Improved efficiency in every detail of the operation of power generating facilities is one answer to the ever-increasing demands for more power.

That's why leaders in the power field choose Pritchard cooling towers. They know that Pritchard heavy-duty towers—like these shown here built for the diesel power plant in Nebraska City, Nebraska—are designed *right* . . . engineered with adequate capacity . . . to do any required cooling job at minimum operating expense. Consult Pritchard—a founder member of the Cooling Tower Institute—to be sure you get *guaranteed performance* . . . *maximum efficiency* . . . from your next cooling tower.



Pritchard QUINTAIR* Air-Cooled Heat Exchangers

For more efficient . . . more dependable . . . cooling or condensing of liquids, gases or vapors, specify a Pritchard QUINTAIR* air-cooled heat exchanger. Quality construction assures long, trouble-free service . . . skillful design makes all parts that may require attention readily accessible for easy maintenance.

**Registered Trade Name*

Industry's Partner for Progress

Cooling Towers
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Once is not enough!

The need for blood is greater than ever, not only for men wounded in combat, but here at home . . . to cure disease, to meet accidents and disasters, and to prepare for civil defense.

Our quota can ONLY be met, if those who give *keep on* giving . . . regularly!

You CAN give more than once . . . as often as every three months with complete personal safety. The more often you give the more often you save a life. For every pint of blood you give goes to someone who needs it desperately.

Remember . . . once is NOT enough. Give blood again and again! Call your Red Cross, Armed Forces or Community Blood Donor Center for an appointment to give blood today.

GIVE BLOOD

...give it again and again

BUSINESS EXECUTIVES!

CHECK THESE QUESTIONS

If you can answer "yes" to most of them, you—and your company—are doing a needed job for the National Blood Program.

- ◯ HAVE YOU GIVEN YOUR EMPLOYEES TIME OFF TO MAKE BLOOD DONATIONS?
- ◯ HAS YOUR COMPANY GIVEN ANY RECOGNITION TO DONORS?
- ◯ DO YOU HAVE A BLOOD DONOR HONOR ROLL IN YOUR COMPANY?
- ◯ HAVE YOU ARRANGED TO HAVE A BLOOD-MOBILE MAKE REGULAR VISITS?
- ◯ HAS YOUR MANAGEMENT ENDORSED THE LOCAL BLOOD DONOR PROGRAM?
- ◯ HAVE YOU INFORMED EMPLOYEES OF YOUR COMPANY'S PLAN OF CO-OPERATION?
- ◯ WAS THIS INFORMATION GIVEN THROUGH PLAN BULLETIN OR HOUSE MAGAZINE?
- ◯ HAVE YOU CONDUCTED A DONOR PLEDGE CAMPAIGN IN YOUR COMPANY?
- ◯ HAVE YOU SET UP A LIST OF VOLUNTEERS SO THAT EFFICIENT PLANS CAN BE MADE FOR SCHEDULING DONORS?

Remember, as long as a **single** pint of blood may mean the difference between life and death for **any** American . . . the need for blood is **urgent!**

NATIONAL BLOOD PROGRAM

Deaerating Heaters

BY WEIGHT? OR BY DESIGN?

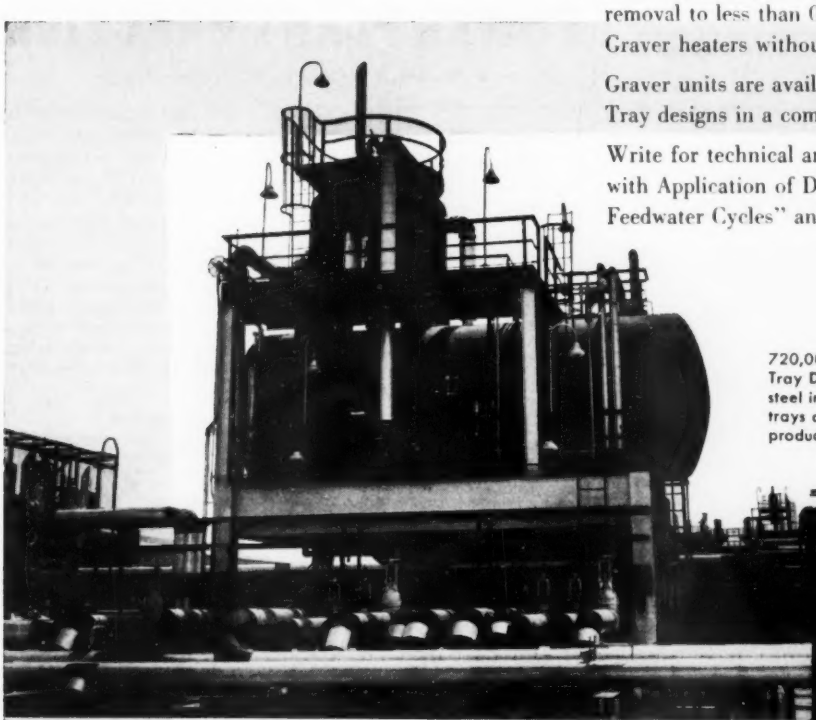
Forty-five years ago, deaerating heaters were built of cast iron trays and outer shells. Cast iron was corrosion resistant, but was also heavy and cumbersome.

Today, Graver's effective design has eliminated the need for this excessive weight. Yet, Graver Deaerating Heaters are corrosion resistant and structurally strong. *Stainless steel* is used for all internal parts in contact with corrosive water or atmosphere as well as for internal vent condenser, trays and trim. All other parts of the vessel are constructed of high grade carbon steel.

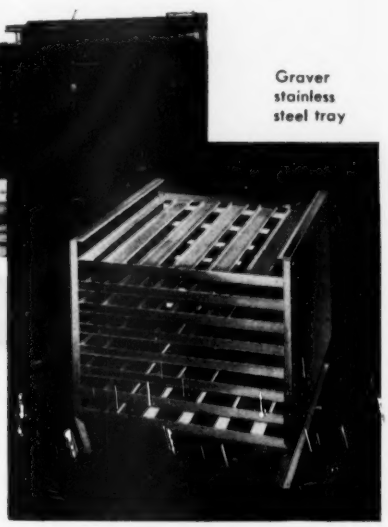
Furthermore, although the weight of Graver Deaerating Heaters has decreased over the years, the efficiency in oxygen removal has increased. Oxygen removal to less than 0.005 ml/liter is obtained in Graver heaters without difficulty.

Graver units are available in Spray, Tray, and Spray-Tray designs in a complete range of sizes.

Write for technical article, "Experiences with Application of Deaerating Heaters in Feedwater Cycles" and bulletins.



720,000 lb. per hr. Graver Spray-Tray Deaerating Heater with stainless steel internal vent condenser and trays at a southwestern metal-producing plant.



Graver stainless steel tray

GRAVER WATER CONDITIONING COMPANY

Division of Graver Tank & Mfg. Co., Inc.

DEPT. P-H, 216 WEST 14th STREET, NEW YORK 11, N. Y.

In Canada: The Bird-Archer Co., Ltd., Cobourg, Ontario

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GRAVER

EQUIPMENT FOR ALL WATER AND WASTE TREATMENT PROCESSES

Deaerating Heaters

GW482

GET PRECISION TUBE ROLLING IN HALF THE TIME!

Here's a new approach to the problem of tube rolling. The automatic VERNON-ORMECO Tube Expanding Machine utilizes a new controlled method of expanding tubes to produce uniformly tight tube joints. All joints are rolled to the same preselected tightness-fit regardless of variations in tubing or I. D. of tube hole. This greatly reduces the danger of leakage and speeds maintenance and manufacturing jobs.

The VERNON-ORMECO Tube Expanding Machine provides an exceptionally rapid operating cycle and is extremely simple to operate.

Features

- ROLLS UP TO 700 TUBE JOINTS PER HOUR.
- ROLLS ALL TUBES UNIFORMLY TIGHT TO PRE-SELECTED TIGHTNESS-FIT.
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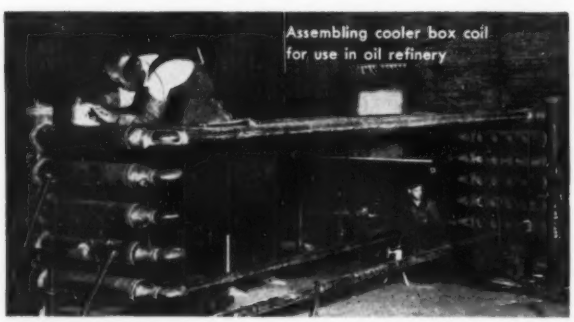
Vernon "Universal" FLAME CUTTER
Brown STEEL VALVES
Vernon-Ormeco TUBE EXPANDING MACHINE



Assembling cooler box coil for use in oil refinery

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No special piping design presents too great a challenge for Western Piping Supply's many specialists. Engineers, pipe benders, welders, or the men who align, heat treat, or test—all have the skill and good judgment bred of long experience. These men stand ready to handle all your pre-fabricated piping requirements, whether of special or conventional design.

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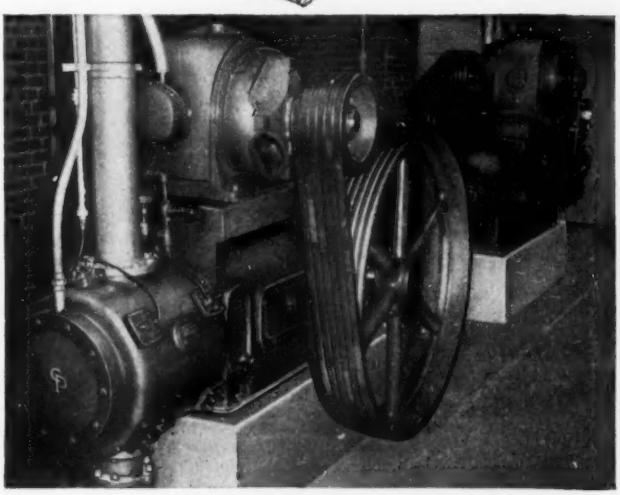
CP compressors pay BIG dividends in dependability



You can really count on CP Compressors for long, dependable service. Designed for continuous, efficient operation, they stay on the job for 25 to 30 years with minimum maintenance. Simplate valves with low, straight lift minimize valve maintenance and assure low power consumption. Correct cylinder design . . . liberal water jackets . . . large streamlined air passages . . . economical regulation with constant speed or automatic start and stop controls — all contribute to economy and dependable operation.

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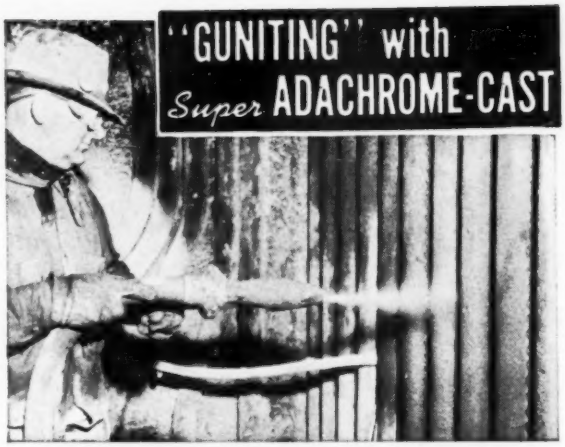

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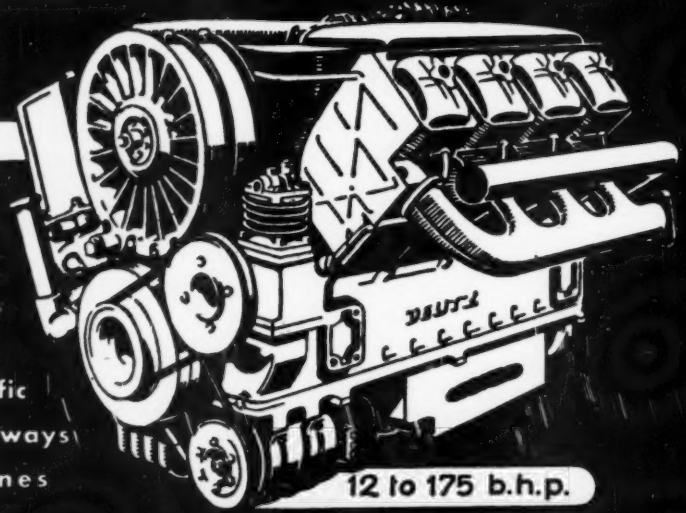

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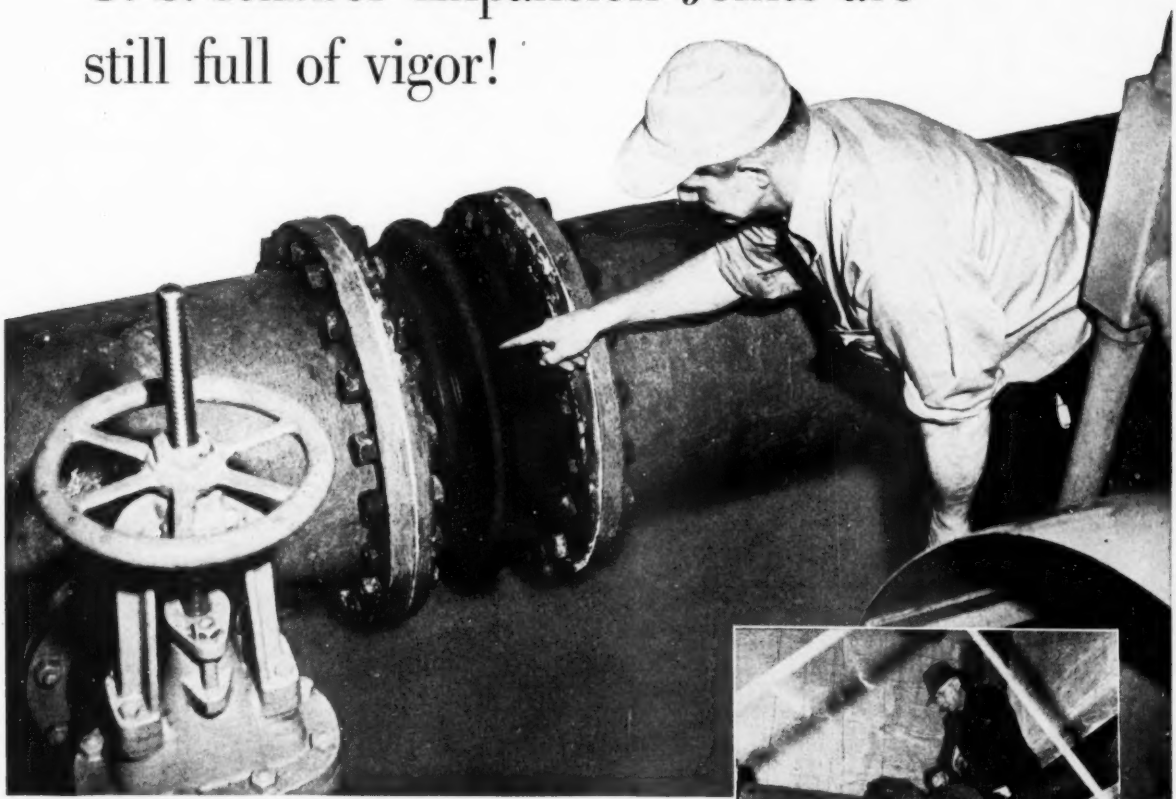
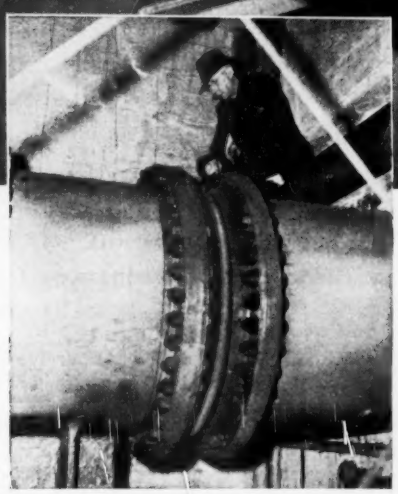
26 years under pressure . . . and these U. S. Rubber Expansion Joints are still full of vigor!





The U. S. Expansion Joints shown here (20" joint, above—48" joint, below) have been conducting cold water into an electric power plant for 26 years, yet are still in good condition.

Yes, for more than a quarter of a century these U. S. Expansion Joints have been connected to the pipe lines carrying cold river water into an electric power plant. They are still in good working condition!

Only United States Rubber Company can claim such service records—for "U. S." is the manufacturer who developed, produced and introduced rubber expansion joints to industry. "U. S." files are filled with long-service records like this.

U. S. Expansion Joints are economical, flexible connections used in pressure and vacuum lines to prevent excess stress due to expansion, contraction and misalignment. In pipe lines, they insulate against vibration and prevent the transmission of noise.

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— Just some of the reasons why so many users prefer

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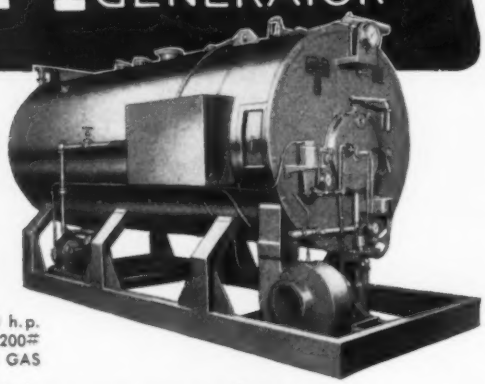

20 SIZES
10 to 600 h.p.
15 to 200# OIL OR GAS

— and here are some others:

★ Eye-level controls — protected from dirt, water and accidental damage

★ AMES SERVICE — our **LOCAL** service man starts your unit and provides 3 months' FREE SERVICE

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for a company with a Water Problem...

1. Costs Far Less to Install!

A Ranney Water Collector will add millions of gallons to your daily water supply—at a fraction of the cost of conventional systems!

2. Less Expensive to Operate!

A Ranney Water Collector is far less expensive to operate —uses fewer pumps, fewer personnel, less power, and usually requires no treatment facilities.

3. Maintenance Requirements Practically Nil!

A Ranney Water Collector requires little or no maintenance. The rate of flow through the Ranney Collector's apertures eliminates clogging and silting. No filter plant maintenance.

4. More Water per Unit!

A single Ranney Water Collector has produced more clear, cool water than ten conventional vertical wells.

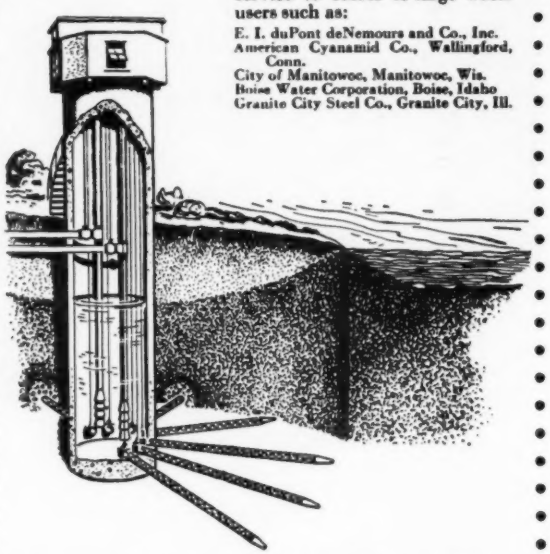
5. Far Longer Life Cuts Depreciation Costs!

The longer life of a Ranney Water Collector lowers financing and depreciation rates appreciably.

6. Ask These Satisfied Users

Ranney Water Collectors are currently rendering excellent service to scores of large water users such as:

E. I. duPont deNemours and Co., Inc. American Cyanamid Co., Wallingford, Conn.
City of Manitowoc, Manitowoc, Wis.
Boise Water Corporation, Boise, Idaho
Granite City Steel Co., Granite City, Ill.



An inexpensive Ranney survey will determine how the Ranney Method can work for you.

If you need water, write us for complete information on how a Ranney Water Collector will solve your problem.

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The Big Header

Also for U.S. Steel's Youngstown, Ohio Plant

Blaw-Knox is also furnishing and installing complete piping for an addition to the power facilities and erecting the new 18,750 KVA turbo-generator with its various auxiliaries.

MANY a big header has been fabricated at Blaw-Knox, but "The Big Header" for U.S. Steel's Youngstown, Ohio plant tops them all! With an over-all length of 36½′ and weighing 10½ tons it will distribute steam from two boilers at 900° F and 950 psi to the 18,750 KVA turbo-generator and auxiliaries. For the heating system and other equipment a reducing station will step steam temperature and pressure down to 600° F and 280 psi. Piping to the turbo-generator is Chrome-Moly Alloy Steel 14″ in diameter with a wall thickness of 0.937″. Shop prefabrication by the Blaw-Knox Power Piping and Sprinkler Division gave far closer control over the finished product than is possible in field fabrication. We will be glad to discuss our ability to cope with any piping problem.

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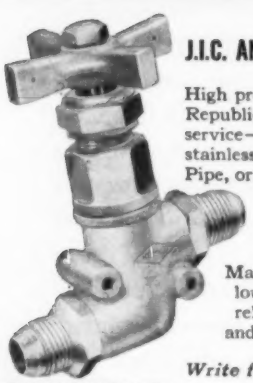

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J.I.C. AND AN STANDARD TUBE ENDS

High pressure needle and globe valves by Republic have forged bodies for super duty service—brass, steel, aluminum alloy, or stainless steel. Exclusive design features. Pipe, or AN or J.I.C. tube ends, or combinations, sizes ⅛" to 1". Operating range: needle—3,000 psi; globe—2,000 psi, –65° to 350°F.

Manufacturers also of high quality low and hy-pressure check valves, relief, 2, 3, and 4-way plug valves, and special valves to specifications.

Write for complete catalog and name of nearest distributor.

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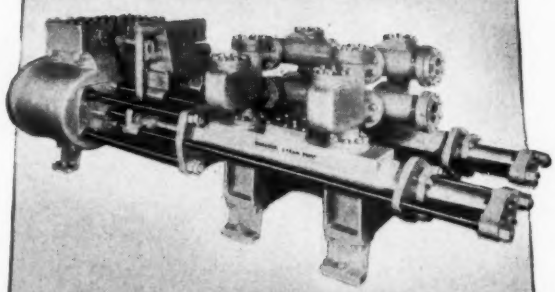
"PALMETTO® 1000" rides the rods—without hardening



PROOF AGAIN THAT QUALITY PACKING PAYS

For WAGENER PUMP CO. of Canton, Ohio, the common pump problem of scored rods due to hardened packing just doesn't exist. In 45 years of using Palmetto 1000 Braided Square Packing on the steam and liquid rods of reciprocating pumps, Wagener has not had to consult on this problem. Savings for Wagener—Savings for Wagener customers!

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What worked for Wagener will work for you ..

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packing more performance into every application

PALMETTO Packings

GREENE, TWEED & CO. North Wales, Pa.

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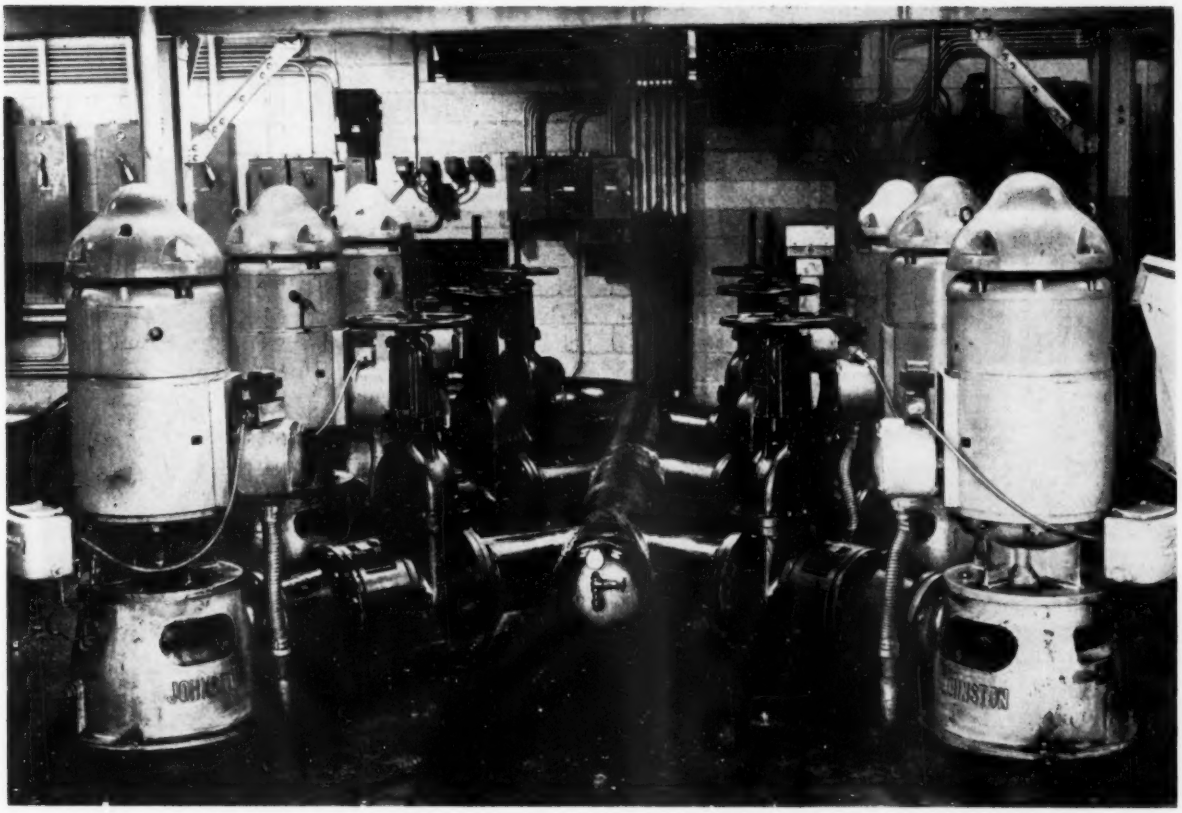

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This is just another typical example of the ability of Johnston equipment to handle all types of pumping jobs in plant operations, large or small. Why not let our trained engineering staff consult with you on the best solution to YOUR particular problem?

Send today for your free copy of our new bulletin describing Johnston Close-Coupled, Vertical Turbine Pumps designed for industrial service. Ask for Bulletin G-113.

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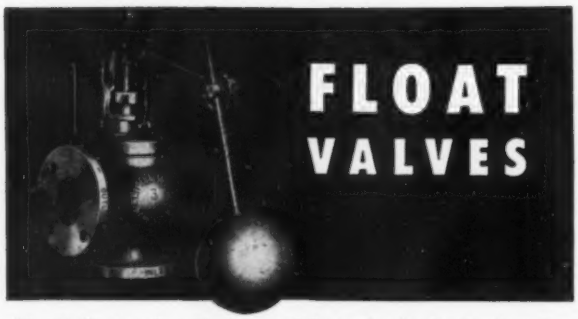

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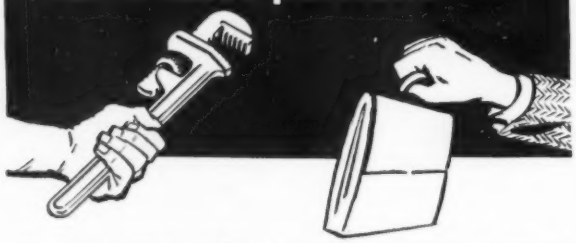
Klipfel VALVES, INC.
HAMILTON, OHIO

To the man who wants to trade his pipe wrench for a sales portfolio



If you are 30 or older... have several years of power plant experience... *really know* boiler operation... and have a desire to improve your position, we'd like to hear from you.

Promotions soon will create openings in established territories in the East and Middle West. These positions will be filled by men with practical, mechanical backgrounds who will be thoroughly trained by us to be Sales Engineers. Salary, commission and expenses. Other benefits include profit-sharing, group insurance, pension plan, paid vacations and sick benefits.

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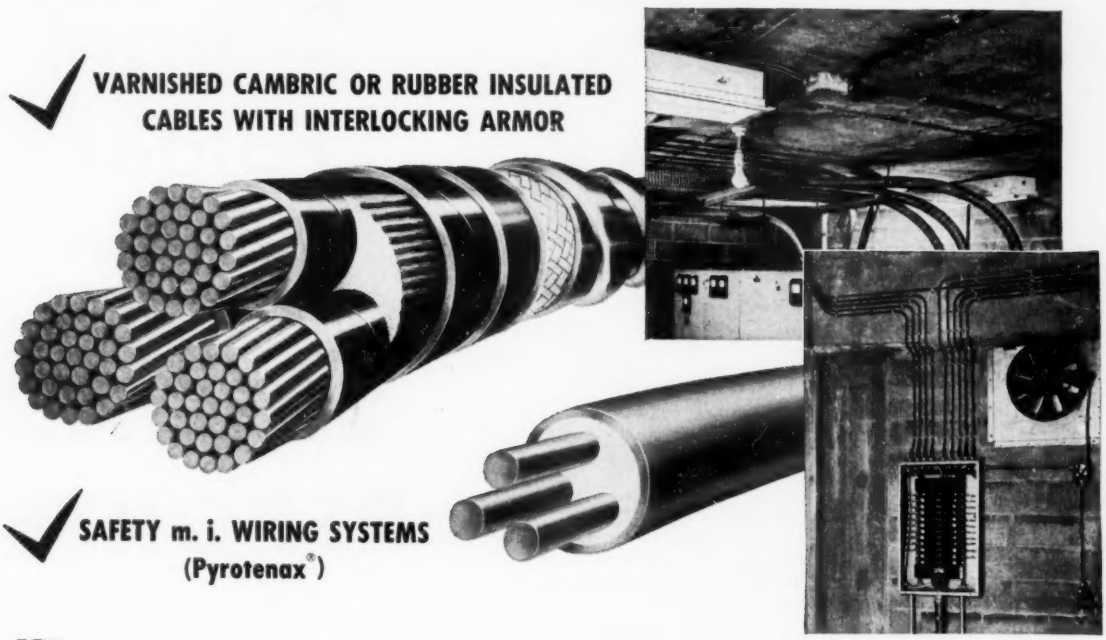
Modern, All-purpose Plant and Equipment Wiring

✓ **VARNISHED CAMBRIC OR RUBBER INSULATED CABLES WITH INTERLOCKING ARMOR**



✓ **SAFETY m. i. WIRING SYSTEMS (Pyrotenax®)**

On any new plant construction job, the General Cable "Power Twins" provide today's modern, flexible wiring team for all power, lighting, control and machine tool applications. Can easily be shaped on the job. Especially economical and adaptable in close areas under and around beams and pillars.

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Super Service Portable Cords and Cables for power, lighting, control and machine tool leads to bussways, small tools in plants, etc.

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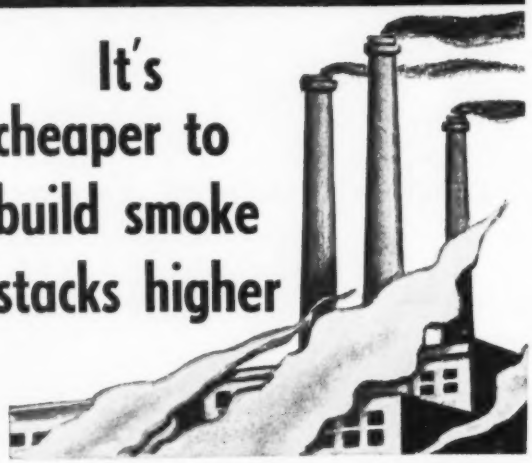
It's cheaper to build smoke stacks higher



...if you know the meteorological facts

Why did a smelter in the southwest first build its smoke stack 200 feet high . . . then raise it to 350 feet . . . and then raise it again to 455 feet to eliminate SO^2 pollution?

Over the years they had learned more from the scientific progress in "stack meteorology" as a practical way to eliminate pollution at ground levels.

They learned the hard way. You can do it the easy way.

5 Basic Patterns of Smoke Behaviour

Meteorologists studying smoke behaviour under almost all kinds of turbulence, temperature and humidity conditions have come up with some basic answers for forecasting smoke behaviour.

This knowledge applied to your plant location and your air pollution problem will help guide you to the solution on a broad level.

At Bendix-Friez we offer you meteorological equipment that has set the standard of the world for 77-years. We offer too, all the experience of others who have made use of Bendix Friez meteorological equipment in their own problems of pollution.

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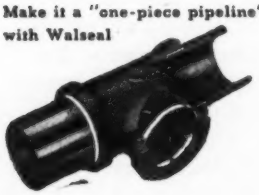

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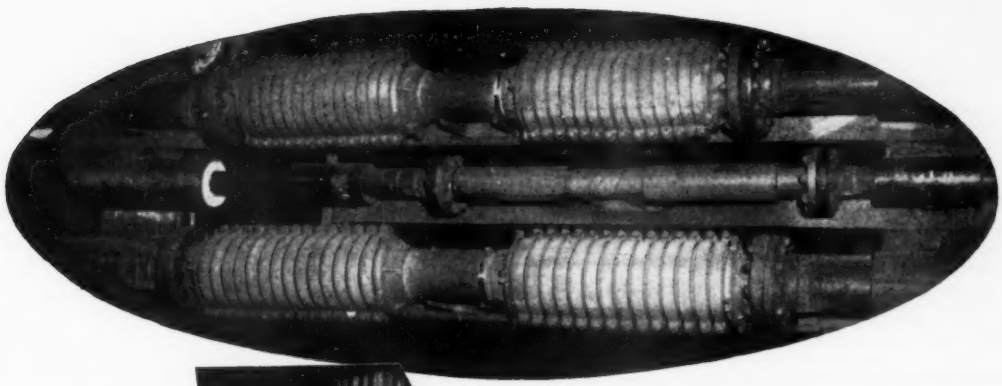

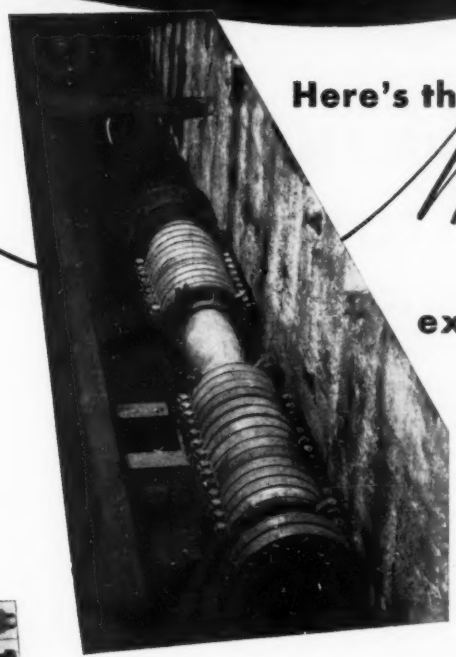

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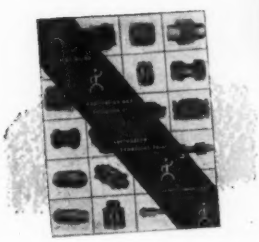

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The Flexon Expansion Joint Design Guide gives detailed specifications, and selection and application data for Flexon Expansion Joints. Write for your copy or see Flexon Expansion Joint Catalogs in Sweet's, Chemical Engineering Catalog and The Refinery Catalog.

You can have all the advantages of leakproof, maintenance-free pipeline motion control in a compact, easy-to-install, in-line unit when you use Flexon Expansion Joints. There is no repacking . . . no bulky, space-consuming installation . . . just install the Flexon Expansion Joint as easily as putting in a fitting, and then forget it.

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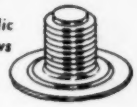

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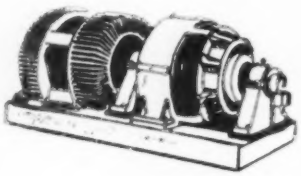

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WANTED A position as Chief Operating Engineer 20 years experience in the operation and maintenance of steam power plants, married, age 47, best of reference. PW-9443, Power.

WANTED—PERMANENT work by experienced power house operator. High pressure steam turbines, boilers and diesel, best of reference. PW-9368, Power.

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3 Phase, 60 Cycle, 220 or 440 Volts (*2200 volts or higher)

HP	Make	Type	Speed
1750	*G. E.	K	3600
1000	*G. E.	K6347S	1800
750	*A. C.	TEFC	1800
750	*G. E.	KT	720
700	G. E.	FT	3600
500	*A. C.	6316SW	1800
400	*G. E	KF559	3600
300	*West.	CS	3600
250	*L. Allis	OGX148	720
250	G. E.	IK	600
200	*G. E.	FT549Y	3600
200	A. C.	ARWX	3600
200	*G. E.	IK13B	1800
200	A. C.	ARWWT	600
200	G. E.	IK17	600
200	*West.	CS	600
200	*G. E.	K6325S	514
150	A. C.	AR DP	3600
150	*A. C.	AN	1800
150	G. E	IK13A	1800
150	G. E.	IE-K	1200
150	G. E.	KT558	900
150	*G. E	KT566 TEFC	720
150	G. E.	IK16	600
150	*West.	CS 3-brg.	600
125	West	CS504S	3600
125	*A. C.	AR226	1800
125	*Reliance	AA6085 BB	900
125	A. C.	AR	900
100	L. Allis	EX114SExPr	3600
100	*G. E.	FT542Z	1800
100	G. E	FTRP543	1800
100	*West.	CS	1800
100	A. C	AW	1200
100	G. E	IK13A	1200
100	U. S.	CFU (vert)	1200
100	*West.	CS (vert)	1200
100	*West.	CS774C	900
75	West.	CS445S	3600
75	G. E.	KT537	1800
75	G. E.	IK11A	1800
75	A. C.	AR505	1200
75	Howell	TEFC	1200
75	G. E.	KF542 BB	1200
75	*A. C.	AR (vert)	900
75	A. C.		900
75	A. C.	AN	720
75	G. E.	IK	600
75	Fair-Mor	H24B BB	514
60	G. E.	KF444Z	3600
60	*West.	CS504S	1800
60	A. C.	APZ445S TEFC	1800
60	*West.	CS505S TEFC	1800
60	*G. E.	KT537	1800
60	A. C.	APZ504U TEFC	1200
60	West.	CS752C	1200
60	West.	GS857C TEFC	1200
60	A. C.	AR504U	1200
60	*G. E.	KT343	1200
60	G. E.	KT343	1200
60	Cr.-Wh	SC505	1200
60	A. C.	AR823	900
60	A. C	AR826F	514
50	G. E	K404	3600
50	West.	CS205S	3600

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HP	Make	Type	Speed
2000	*G. E.	MT-12	600
2000	*G. E.	MT-30	237
1500	*G. E.	MT-30	240
1250	*West.	CW	600
1000	*West.	CW	250
700	*A. C.	ANY	720
500	*G. E.	IM	3600
500	*G. E.	MTP	1800
500	*G. E.	MT	450
500	West.	CW	350
400	A. C.	3-brg	450
400	*G. E.	MT412	450
350	West	CW	900
300	*G. E.	IM13A	1800
300	*G. E.	MT410	450
250	West.	HF15H	600
200	G. E.	IM15	1200
150	G. E.	MT549 BB	1800
125	*G. E.	MT549	1800
125	G. E.	IM15A	600
100	A. C.	ANY	900
100	G. E.	IM13A	1800
100	G. E.	IM15A	450
75	Northw'n	HW50	1800
75	G. E.	MT347	1200
75	G. E.	MT356	900
75	G. E.	IM	720
75	G. E.	IM14	600
60	West	CW762C	900
50	G. E.	IM11A	1800
50	*A. C.	ARY	1800
50	West.	CW636A	1200
50	G. E.	MT346	720
50	G. E.	IM14	450
40	*G. E.	MT532	1200
40	G. E.	MT336	1200
35	Fair-Mor.	UAB (vert)	1800
35	G. E.	IM	1200
30	G. E.	MT532	900
30	G. E.	MT326	1200
25	G. E.	MT522	1200
25	G. E	MT526	900
25	G. E.	MT536	720
20	G. E	MT322	1200
20	G. E.	IM	900
20	G. E.	MT322	900
20	G. E	IM11A	720
20	G. E.	IM12	600
15	L. Allis	OH326	1800
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KVA	Make	Phase	Primary	Secondary
1000	West.	3	4800	480
850	West.	3	34160	455
667	G. E.	1	3000	480
500	American	1	2400	240/480
400	West. (air)	3	12000	213
300	G. E.	3	13800	240/480
300	G. E.	3	2400	240/480
250	G. E.	1	4160	240/480
200	Wagner	1	2400	575
167	A. C.	1	2400	120/240
100	Pittsburgh	1	2400	575
100	Pittsburgh	1	2400	240/480
100	American	1	2400	240/480
100	G. E. (Py'l)	1	2400	120/240
50	West.	1	2400	120/240

AC SYNCHRONOUS MOTORS

3 Phase, 60 Cycle, 220 or 440 Volts (*2200 volts or higher)

HP	Make	Type	P.F.	Speed
1420	*West.		.7	900
800	*G. E.		1.0	1800
710	*G. E.	ATI	1.0	720
700	*G. E.	TS975Z	1.0	1200
600	*G. E.	TS7640	1.0	900
600	*G. E.	TS	1.0	600
600	*G. E.	ATI	1.0	240
400	West.	HG	1.0	900
300	G. E.	ATI	.8	1200
300	G. E.	ATI	.8	900
300	*G. E.	ATI	1.0	720
300	Ideal	SNS	1.0	257
250	*Cr. Wh.	2518S	1.0	1800
220	*West.		1.0	600
190	El. Mhy.	2S	1.0	720
175	*West.	HR	1.0	360
150	*West.	HR	1.0	300
125	*G. E.	ATI	1.0	900
125	*El. Mhy.		1.0	900
125	*G. E.	TS	1.0	277
115	El. Mhy.	EM	1.0	240
100	*G. E.	ATB	.8	900
100	*West.		1.0	900
100	Ideal	SNS	1.0	900
100	G. E.	TS6184	1.0	450
20	Fynn-W	15VRN		1200
15	Ideal			1800
15	Century	ARC365	1.0	1200
7½	Ideal			1800

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AC SYNCHRONOUS GENERATORS

3 Phase, 60 Cycle, 220 or 440 Volts (*2200 volts or higher)

KVA	Make	Type	Speed
1750	*West		900
1500	G. E.	ATI	720
312	G. E.	ATI	900
300	*G. E.	ATI	720
225	G. E.	ATB	600
187	West.	ES	720
100	*G. E.	ATB	900
60	Fair.-Mor.	B	900
55	G. E.	ATB	1200
50	G. E.	ATB	1200
50	West.		1200
50	G. E.	ATB	900

M. G. SETS

KW	Make	AC	DC
2400	West. (3-u.)	4800	525
1000	West. (3-u.)	11000	137/275
500	AC-West.	2300	250
450	G. E. (3-u.)	2300	125/250
400	A. C.	2300	120/240
300	Cr. Wh.	440	250
200	G. E.	440	550
200	West.	2300	275
200	G. E.	440	600
150	G. E.	2300/440	250
150	G. E.	2300/4000	125/250
150	G. E.	440	275
125	G. E.	440	300
125	West.	440	250
100	G. E. (25 cy)	440	125
100	G. E.	2300	250
100	Ridgway	2200	275
100	West.	220	125
100	Elec. Machy.	220	125
90	G. E.	220	250
90	G. E.	440	60
75	Reliance	2300/440	250
75	G. E	440	125
60	A. C	2300	110
50	G. E	440	250
40	A. C.	220	125
35	West.	2200	125
30	G. E.	220/440	250
25	Cr.-Wh.	440	125
20	G. E.	440	250
20	Bogue-GE	550	250
20	Bogue-GE	220/440	125

D. C. MOTORS

Mill Type—Pedestal Bearing Reversing

HP	Make	Volts	Speed
1500	West.	525	600
1200	West.	525	600
1000	West.	450	600

230 Volts—Constant Speed

250	G. E. (550 v)	MPC4	700
200	Cr.-Wh.	CM	500
175	G. E.	ELC	750
100	G. E.	RC34	2500
100	G. E.	RC19	575
100	West.	MC90	460
50	G. E.	RC35	700
50	G. E.	DLC-204	650
35	Cr.-Wh.	CM351	700
30	Cr.-Wh.	CCM	440
30	Sprague	C-60	240/300
25	West.	SK100L	1100
25	G. E.	RC32	900
25	G. E.	RC32	800
25	A. C.	E130	775
25	West.	SK133	575

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✓ Complete Stock A.C. & D.C. Motors and Generators

✓ New and "Certified Rebuilt"— UP to 1000 H. P.

A. C. GENERATORS — 60 CYCLE

KVA	Mfr.	Type	Volts	Speed
1000	Whse syn cond		4000/2300	900
625	Gen Elec	ATB	2300	450
625	G E 25 cycle	ATB	2300	750
600	Gen Elec	ATB	480	900
625	El Machy	Late	240/480	1200
485	Allis Ch	1 brg	480	400
350	El Machy	1 phase	480	1200
312	Gen Elec.	ATB	240/480	600
275	G. E. 25 cycle	ATI	480	750
225	El. Machy.		480	720
225	Gen. Elec.	ATI	240/480	900
150	Allis Ch.		240/480	1200
150	Gen. Elec.	ATB	2300	900
150	Whse.		2300/480	600
125	Gen. Elec (2)	ATB	240/480	900
112	Gen. Elec.	ATB	240/480	900
90	Gen. Elec.	ATI	240/480	1200
75	Gen. Elec.	ATI	240/480	1200
75	El. Machy.		2300	900
56	G. E.	ATB	240/480	1200

PLANER MOTOR & CONTROL

75 HP Reliance type 75P, DC 230 V. 250/1000 RPM, with C-H Bul. 6250 magnetic controller. A-1 cond.

D. C. GENERATORS

KW	Mfr.	Type	Volts	Speed
300	Al. Ch.	MECW	125/250	1200
250	Allis. Ch. b.b.	EW	350	1200
200	Gen. Elec.	CD	250	1200
105	Century b.b.	1500 amp.	70	1200
100	Allis. Ch.	E	125	1200
100	Gen. Elec.	RC37	250	1200
75	Whse.	SK	250	900
75	Cont. b.b.	D109X	125	1200
75	Gen. Elec. (2)	CD115	250	1500
60	Whse.	SK160	250	1000
50	Whse.	SK	250	1100
50	Allis. Ch.	EW	125/250	1200
50	Gen. Elec.	RC	125	1200
40	F. Morse b.b	DH	125	1800
40	Gen. Elec.	RC	600	1750
25	Whse.	SK93	125	1750
20	Gen. Elec.	RC	125	1150
15	Star b.b. (10)	SQ	250	1500

ADJUSTO-SPEDE MOTOR

60 HP Allis type OX-504Y b.b. 3/60/220/440 V. 400/1700 RPM with brake and control.

D. C. MOTORS

HP	Mfr.	Type	Volts	Speed
300	Allis. Ch. b b	EW	350	1000
250	Gen. Elec.	MPC	230	450
200	Al Ch. b.b.	E	250	500/1000
150	Whse.	SK-201	230	300/900
100	Gen. Elec. (2)	RC37	230	900
75	Reliance	75P	230	250/1000
75	Whse.	SK170	230	635
75	G. E (2)	CD 115	230	1150
60/75	Gen. Elec.	C	230	500/1200
50	Whse.	SK150	230	750
50	Reliance b.b.	65IT	230	750
50	Gen. Elec.	CD123	230	550/1200
50	Gen. Elec.	RC33	115	1100
50	Cr.Wh.b.b.(3)	FH	230	1750
50	Whse.	SK183	230	300/900
40	Allis. Ch.	E-121	230	1750
40	Gen. Elec. (2)	CD103	230	1150
40	Gen. Elec.	RC32	550	1200
40	F Morse b.b.	DH 120	115	1750
30	Imperial b.b.	D69	230	400/1600
30	Whse.	SK110L	230	1150
30	Star b.b. (3)	SB	230	1750
25	Whse.	SK150	230	300/1200
25	Gen. Elec.	CD85	230	1750
25	Gen. Elec.	CD105	230	575/1720
20	Century b.b.	DN330	230	3500
20	G. E. series	CO-1826	230	875
20	Whse. b.b (2)	SK97	550	900

A. C. MOTORS—60 CYCLE

HP	Mfr.	Type	Volts	Speed
800	G. E.	Slipring	2300	400
750	Whse.	Synch.	2200/4000	900
700	G. E	Synch	2200	514
600	G. E.	Synch.	220/440	257
600	E M	Synch.	480	1200
600	G. E. (2)	Synch.	2200/440	360
550	G. E.	Sq. Cage	2200	3600
500	G. E.	Sq. Cage	6600/4000	1800
500	G. E.	Synch.	440	900
450	Allis. Ch.	Synch.	480	400
450	Whse.	Sq. Cage	2200	514
400	G. E.	Synch.	440	450
400	Allis. Ch.	Sq. Cage	2200	1200
350	Whse. (2)	Slipring	2300	450
350	G. E.	Slipring	2200/440	600
300	Allis. Ch.	Slipring	220/440	900
300	Al. Ch.	Sq. Cage	2200/440	720
300	Whse.	Synch.	2200/440	600
300	Al. Ch.	Slipring	2300	514
300	G. E.	Slipring	440	360
250	G. E.	Slipring	2300	450
250	G. E.	Synch.	220/440	720
250	Whse. (2)	Sq. Cage	2200/440	1200
250	L. A. (2)	Sq. Cage	2200	1800
225	G. E.	Synch.	220/440	900
200	Allis. Ch.	Slipring	440	450
200	Gen. Elec.	Sq. Cage	2200/440	720
200	G. E.	Sq. Cage	220/440	600
200	Cr. Wh.	Sq. Cage	220/440	3600
200	Whse.	Sq. Cage	2200/440	900
200	G. E.	Slip Ring	220/440	600
200	E. M.	Synch.	220/440	1200
200	G. E.	Sq. Cage	220/440	1200
200	G. E.	Slipring	220/440	360
200	Whse.	Sq. Cage	220/440	1800
200	Rel. b.b.	Sq. Cage	220/440	1200
200	E. M.	Synch.	220/440	514
175	Whse.	Synch.	220/440	360
160	Whse.	Synch.	220/440	600
150	Whse.	Sq. Cage	220/440	900
150	G. E. TEFC	Sq. Cage	2200	3600
150	Allis Ch.	Slipring	2200/440	720
150	G. E. (2)	Sq. Cage	2200/440	720
150	G. E.	Slipring	220/440	450
150	Allis. Ch.	Sq. Cage	2200/440	1200
150	Rel. b.b.	Sq. Cage	220/440	1800
150	Allis Ch.	Sq. Cage	440	450
125	Rel. TEFC	Sq. Cage	220/440	1800
125	G. E. (2)	Slipring	220/440	600
125	G. E.	Slipring	220/440	450
125	E. M. (2)	Synch.	220/440	1800
125	G. E	Slipring	2200/440	720

M-G SETS

KW	Mfr.	Input V		Output V
500	Whse.*	2300	AC	250 DC
300	Whse.*	2300	AC	250 DC
300	Allis. Ch.	2200/440	AC	125/250 DC
300	Whse.*	2300	AC	600 DC
250	Allis. Ch.	2200/440	AC	350 DC
250	Cr. Wh.*	2200/4000	AC	250 DC
200	Whse.* (2)	220/440	AC	55 DC
200	G. E.*	220/440	AC	250 DC
200	Gen. Elec.*	220/440	AC	125 DC
150	Whse.*	2200/440	AC	275 DC
105	Century b.b.	220/440	AC	70 DC
100	Al. Ch.	220/440	AC	125 DC
100	Delco b.b.	220/440	AC	125/250 DC
90	G. E.* (2)	220/440	AC	125 DC
80	Star* b.b.	220/440	AC	240 DC
75	Cont. b.b	220/440	AC	125 DC
75	G. E. (2)	220/440	AC	250 DC
60	Gen. Elec.*	220/440	AC	60 DC
50	Whse.	220/440	AC	250 DC
50	Gen. Elec.	220/440	AC	125 DC
50	Allis. Ch.	220/440	AC	125/250 DC
45	Gen. Elec.*	220/440	AC	60 DC
40	G. E. (2)	220/440	AC	250 DC
40	Gen. Elec.	220/440	AC	600 DC
30	Otis (5)	220/440	AC	250 DC
25	Whse.	220/440	AC	125 DC
25	Gen. Elec.	220/440	AC	250 DC
20	Star b.b.	220/440	AC	120 DC

*Synch. motor.

THESE ARE PARTIAL LISTINGS . . . 10,000 OTHER UNITS IN STOCK

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New WAGNER MOTOR-GRAM lists hundreds of bargains in new and rebuilt Electric Motors and Generators. Write today!

OUR 47th YEAR

Serving American Industry

ARTHUR WAGNER COMPANY

1435 W. RANDOLPH ST. • CHICAGO 7, ILLINOIS

TELEPHONE MOnroe 6-7409

SLIP RING MOTORS

220 or 440 volt, 60 cycle, 3 phase, slip ring Motors Rebuilt

H.P.	Make	Type	Speed	Description
400	G.E.	I-M	1200	S.B.
300	G.E.	I-M	1200	S.B.
200	G.E.	I-M	1200	S.B.
150	G.E.	I-M	1200	S.B.
150	G.E.	I-M	1800	S.B.
100	G.E.	MT-300	1800	S.B.
100	G.E.	I-M	900	S.B.
100	G.E.	I-M	720	S.B.
75	G.E.	MT-343	1200	S.B.
75	G.E.	I-M	900	S.B.
75	West.	CW	720	S.B.
75	G.E.	I-M	720	S.B.
60	G.E.	MT-333	1800	S.B.
40	G.E.	I-M	1800	S.B.

BRAND NEW SQUIRREL CAGE MOTORS

Totally enclosed, fan cooled, explosion proof, open 220 or 440 Volt, 60 Cycle, 3 Phase

H.P.	Make	Type	Speed	Description
150	G.E.	K-6326	3600	TEFCBB
150	G.E.	K-6326	1800	TEFCBB
125	G.E.	K-6326	1200	TEFCBB
100	West.	CS-607S	1800	TEFCBB
100	West.	CS-504	1800	B. B. open
75	West.	CS-504	3600	TEFCBBXP
75	A.C.	ARZ	1800	TEFCBBused
75	West.	CS-504	1800	TEFCBBXP
75	West.	CS-445	1800	B. B. open
75	F.M.	QS-445	1800	B. B. open
75	West.	CS-505	1200	TEFCBBXP
60	West.	K-594S	1800	TEFCBBXP
60	G.E.	OG-44	1800	TEFCBBXP
60	L.A.	QS-444	1800	B. B. open
60	F.M.	FB-404	3600	B. B. open
50	Master	K-445	1800	TEFCBBXP
50	G.E.	K-405	1800	TEFCBB
50	G.E.	CS-445	1200	S. B. drip
50	West.	K-505	900	S. B. open
50	G.E.	AR-444	3600	TEFCBBXP
40	A.C.	KF-365S	3600	TEFCBBXP
40	G.E.	CS-405	1800	B. B. Splash
40	West.	K-405	1800	TEFCBB
40	L.A.	404	1800	TEFCBBXP
40	G.E.	CS-504S	1800	B. B. open

REBUILT SQUIRREL CAGE MOTORS

220 or 440 Volt, 60 Cycle, 3 Phase, Open

H.P.	Make	Type	Speed	Description
200	Wagner	RP-2-26	1800	S. B.
200	Wagner		1200	S. B.
200	G.E.	K-564	900	B. B. new
150	West.	CS	1800	S. B.
150	G.E.	I-K	1200	S. B.
150	G.E.	I-K	720	S. B.
100	West.	CS	1800	S. B.
100	G.E.	I-K	1800	S. B.
100	G.E.	I-K	1200	
100	G.E.	KT-347	1200	S. B.
100	West.	MS	1200	S. B.
100	West.	CS	900	S. B.
100	G.E.	I-K	720	S. B.
75	West.	CS	1800	S. B.
75	West.	CS	1200	S. B.
75	G.E.	I-K	900	
75	G.E.	KT-343	1200	S. B.
75	West.	CS-WL-607	1200	S.B. B.
75	G.E.	KT-552	900	S. B.
75	G.E.	KT-352	900	S. B.
75	G.E.	KT-346	720	S. B.
60	G.E.	KT-333	1800	S. B.
60	G.E.	I-K	1200	S. B.
60	West.	CS	1200	S. B.
60	G.E.	KT-346	900	S. B.
60	G.E.	I-K	900	S. B.
50	G.E.	I-K	1800	S. B.
50	Cr. Wh.	25R	1800	S. B.
50	G.E.	KT-327	1800	S. B.
50	G.E.	KT-336	1200	S. B.
50	West.	CS	1200	S. B.

We have in stock explosive proof motors 220/440/60/3 ranging in HP from ½ to 50 HP 900 to 1800 RPM. We also carry in stock a large quantity of used electric motors from 1 hp up to 500 HP., generators, transformers and control equipment. Upon receipt of your inquiries, we shall be glad to quote.

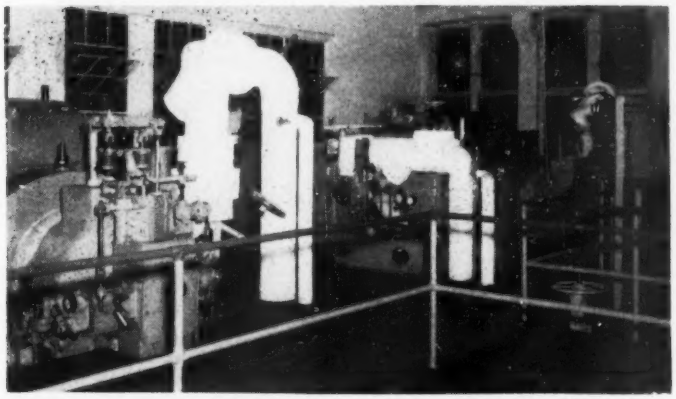
POWER

EQUIPMENT COMPANY

8 CAIRN ST., ROCHESTER 2, N. Y.

P. O. BOX 534 — Tel: Genesee 5629

2250 K.V.A. G.E. CONDENSING TURBINE GENERATOR



Above cut shows our 2250 KVA. General Electric Condensing Marine Type Turbine Generator. A Complete Machine with Condenser.

A HIGH EFFICIENCY UNIT 440# PSIG., 750# F.T.T. CONDITION LIKE A NEW UNIT

SPECIFICATIONS

TURBINE

Manufacturer	General Electric
Capacity	2250 KVA Type FSN
Speed	3600 RPM
Steam Pressure	440# psig., 750°FTT
Exhaust Pressure	2-in. Abs. H.G.
Serial Number	62794

GENERATOR

Manufacturer	General Electric
Capacity	2250 KVA, Unity PF
Speed	3600 RPM
Voltage	3/60/480 Will rewind for any standard voltage
Exciter	110 Volts
Serial Number	5679091

WATER RATES 440 psig., 750° F., 3600 RPM

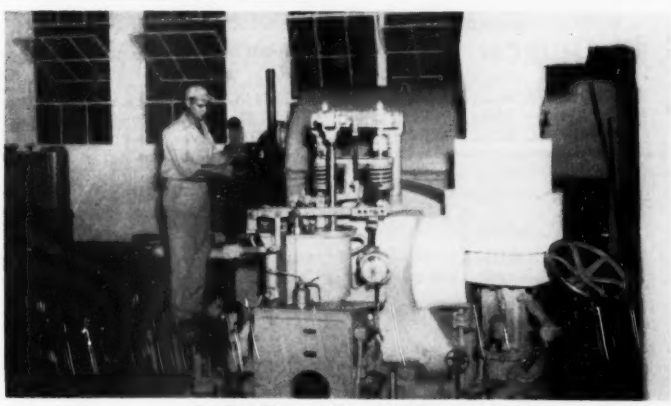
Full Load	2250 KVA	10.9 KWHR.
1125 Load	50% Load	12.0 KWHR.
1687 Load	75% Load	11.0 KWHR.

CONDENSER

Surface Type — Capacity—3600 sq. ft.

INSPECTION REPORT BY GENERAL ELECTRIC WIL BE MAILED TO YOU UPON REQUEST. DRAWINGS AND COMPLETE DATA ARE AVAILABLE. WE HAVE SOLD A LARGE NUMBER OF TURBINES OF THIS SAME DESIGN. THEY ARE BUILT FOR LASTING SERVICE.

WE INVITE INVESTIGATION.



An End View of the 2250 KVA Unit

New England Representatives
FLAGG, BRACKETT & DURGIN, INC.
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Boston 11, Massachusetts
Tel: Hubbard 2-4120

CHARLES WEAVER
4145 PENOBSCOT BLDG.
DETROIT 26, MICHIGAN

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We have a large stock of other turbines. Anything from 300 KW to 10,000 KW. Also boilers and diesel engines. Send us your specifications for anything wanted in power plant machinery.

There's more than 40% to 60% SAVINGS on

SCHOONMAKER DEPENDABLE DIESEL POWER

because:

Each Schoonmaker-sold Diesel Engine Unit is fully REMANUFACTURED in our plants by highly skilled, factory-trained Diesel engineers. Only genuine factory-made and approved parts are used and all REMANUFACTURING is in strict accordance with manufacturer's recommended procedures. Prior to shipment every engine is subjected to a FULL LOAD operating test in accordance with DEMA standards.

The Schoonmaker Plants and Warehouses located in Jersey City, N. J. and Sausalito (San Francisco), California give NATIONWIDE SERVICE from Coast to Coast with modern, efficient and reliable facilities.

Our reputation and many years of experience and SPECIALIZATION in Diesel power equipment gives you value that money cannot buy elsewhere.

So—Buy SCHOONMAKER because you buy the FINEST in DEPENDABLE DIESEL POWER.

America's largest source of New and Remanufactured Diesel Power

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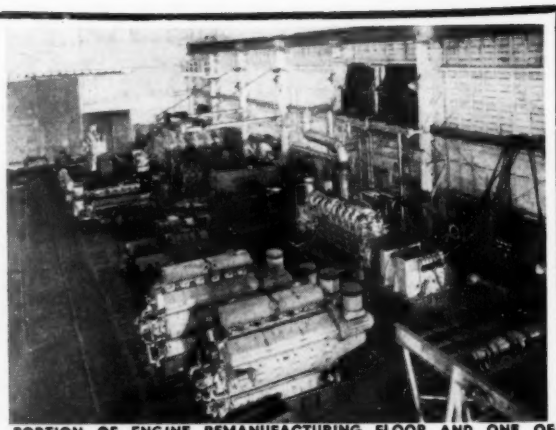

PORTION OF ENGINE REMANUFACTURING FLOOR AND ONE OF THE ENGINE TEST STANDS AT OUR SAUSALITO, CALIF. PLANT

A PARTIAL LIST OF OUR INVENTORY

KW	MAKE	MODEL	HP	RPM
1980	Nordberg	TS-217	3000	225
1136	Fairbanks Morse	38D	1600	720
1100	General Motors	16-278A	1600	720
1000	General Motors	16-567B	1440	720
750	General Motors	12-567	1080	720
500	General Motors	8-278A	750	720
500	Baldwin	VO-8	750	514
500	Alco	6-12½x13T	750	600
500	General Motors	8-567	720	720
480	Worthington	DD-8	700	360
400	Ingersoll-Rand	S-8	600	720
350	Baldwin	VO-6	510	450
320	Enterprise	DSG-6	460	450
300	General Motors	8-268A	450	1200
250	Fairbanks Morse	33-D	375	360
200	General Motors	8-268A	350	900
167	Ingersoll-Rand	S	255	600
160	Buckeye	80	240	600
150	Worthington	CC-4	225	450
100	General Motors	3-268A	150	1200
100	Worthington	BB-5	150	600
60	General Motors	6-71	90	1200

ALTERNATING AND DIRECT CURRENT UNITS
STANDARD AND SPECIAL VOLTAGES AS REQUIRED

ONE YEAR GUARANTEE!

A FEW SPECIALS

BOILERS

Cleaver Brooks model OB25, 8600 lbs. steam, 200 lbs. pressure, Oil fired. "1949"

Combustion Engr. Premier #30, 236 HP semi-portable, steel encased, firetube, 150 lbs. pressure "1949"

1000 H.P. Combustion, 4 Drum, 200#
812 H.P. (2) Combustion, 4 Drum, 300#
500 H. P. (2) BW straight tube 200#
400 H.P. BW 3 Drum, 160# "1949"
300 H.P. BW 200# Sec. HDR
250 H.P. BW 3 Drum, 225# "1948"
205 H.P. Scotch, 175#, Oil
100 HP Cleaver Brooks, 150# (Package)
70 HP Cleaver Brooks, 15# (Package)

TURBO UNITS, non-condensing

937 KVA GE 480/240 v.; O/15# bp
625 KVA Al.Chal.-Elliott 480/240 v.; O/15# bp
375 KVA Al.Chal.-Elliott 240/480 v.; O/25# bp

STEAM ENGINE UNITS (Uniflow)

375 KVA (2) Wghse.-Skinner, 3/60/600 v.
312 KVA GE-Skinner 240/480 v.
250 KVA (2) GE-Skinner, 240/480 v.
187 KVA Wghse.-Ames vertical, 240/480 v. Turbine; 560 H.P. Murray (New)

DIESEL UNITS (Modern)

1136 KVA (4) FM, opposid piston, 720 rpm
1000 KVA Elliot-DeLa Vergne 200 RPM
490 KVA FM, 33C14; 300 RPM
438 KVA GE—Winton (General motors)
300 KVA Fairbanks Morse 277 rpm
250 KVA FM, 33E14; 300 RPM
220 KVA (2) W hse-Buckeye "E" 400 rpm
187 KVA Ideal-Buckeye "E" 400 rpm
185 KVA FM, 32E14; 300 RPM
125 KVA (two) General Motors 1200 rpm
125 KVA GE-Hercules, 300 RPM

GAS ENGINE UNITS

250 KVA GE-Cooper Bessemer, 450 rpm, GS-6
750 KVA EM-Worthington, 360 rpm, DDG-8

POWER PLANT EQUIPMENT CO., INC. 39 Cortlandt St. New York, N. Y.

1000 KW DIESEL GEN. SET

6 Cylinder, Air Start, Bosch Inj. System, Nelseco Diesel Engine, 300 RPM, direct coupled to: General Electric AC, 1000 KW, 3/60/2400 Volts, including: Starting Auxiliaries, Switchboard, and Spare Parts. Overhauled, ready to ship.

Various other makes and sizes in stock, AC & DC Units.

ALJON ELECTRIC DIESEL CO.

904-10 Pacific St. Brooklyn 38, N. Y.
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STORAGE & PRESSURE TANKS

Located Mich.-Mo.-Fla., N.J. & Conn.

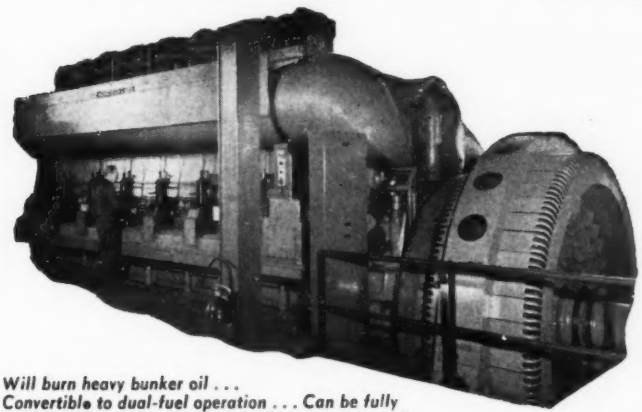
8—12,000-17,000 & 20,000 Gal. 90 Lb.
16—10,000-15,000 & 20,000 Gal. Storage
9—42,000, 120,000 & 240,000 Gal. Storage
10—10,000 Gal. Cap. RR Car Tanks

LESTAN CORP., ROSEMONT, PA.

CURRENT MODEL · · DIESEL

1980 KW NORDBERG MODEL TS-217 DIESEL UNIT

Heavy Duty • Slow Speed • Available Immediately



Will burn heavy bunker oil . . .
Convertible to dual-fuel operation . . . Can be fully inspected and test run . . . ONE YEAR GUARANTEE

ENGINE: (2800 BHP net) Nordberg, 7 cylinder, 2 cycle Diesel engine at 225 RPM, 21¼" bore, 29" stroke, cylinders arranged vertical in line, solid injection.

GENERATOR: 1980 KW, 2475 KVA General Electric generator, 2400/4160/6900 volts, 3 phase, 60 cycle service at 225 RPM.

(50 cycle rating 1650 KW at 187 RPM)

UNIT AUXILIARIES AND ACCESSORIES

Complete standard engine auxiliaries and accessories including filters, strainers, pumps, gauge board, pyrometer, thermocouples, exhaust muffler, lubricating oil cooler, Young evaporative type cooler for jacket water cooling, thermostatic control valve, fuel oil day tank with transfer pump and oil meter, 2 lubricating oil storage tanks, lubricating oil transfer pump, Diesel-driven air starting unit, air tanks, air intake filter, special engine tools, all station piping, including flanges, adapters, valves, and fittings, for air intake exhaust, water, lubricating oil, fuel oil, and air. Generator and exciter control switchgear.

The unit above affords a rare opportunity to procure a complete, modern current model, heavy duty, slow speed diesel set at a great saving. It represents an offering which cannot be duplicated anywhere in the diesel market today.

Act now . . . Phone, Wire, or Write for Full Details

ALL OWNED AND OFFERED EXCLUSIVELY BY

TELEPHONE
DIGBY 9-4350

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A.G.

"America's Largest Source of New and Remanufactured Diesel Power"

SCHOONMAKER CO., INC.

Western Union — WUX —
A. G. Schoonmaker Co. Inc., N. Y.
CABLE:—AGSCOMACH

50 CHURCH ST., NEW YORK 7, N. Y.

Plants and Warehouses: Jersey City, N. J. and Sausalito (S.F.), California

FOR SALE

NORDBERG UNIFLOW ENGINE GENERATOR SET

Engine 24" x 36" Right Hand #29712. Has new cylinder and cylinder heads, all new valves Automatic oiling system. Automatic over speed stop. Speed and exhaust valves can be changed while engine is in operation. Operates at 150 RPM, 125 to 200 lbs. steam pressure, 0-25 lbs. back pressure or on vacuum.

Direct connected to—675 KVA Burke A.C. Generator #89079, type A.C. 900, 3 ph., 60 cy., 480 volts. Can be easily reconnected to 2300 volts, 150 RPM Was originally 2300 volts.

D.C. Exciter Burke #88912—25 KW, 5?0 RPM, 110 volts, 227 amps., chain drive.

Switch Board Panel—A.C. & D.C. Ammeter, A.C. & D.C. Volt Meter, Oil Switch General Electric Diactor Regulator Watt Hour Recording Meter.

Floor space 19'3" x 32'6". On foundation, May be seen running, in perfect shape, covered by Hartford Insurance at present. Will take equipment in trade or time contract.

OFFERED AT $16,000.00

ARTHUR G. PORTER

Lutsen **Minnesota**

ELECTRICAL EQUIPMENT

REBUILT N.I.S.A. STANDARDS

AC Motors — 3 phase 60 cycle

HP	Speed	Make	Wdg.	Type & Disc.
500(3)	1800	West.	Syn. 2200 V.	PedBrgW/Exc
450	1800	AC	SC 2200 V.	AW-SB
350	1800	AC	SC 2200 V.	AW-SB
200	1800	GE	SC	K6333S TEFC
150	1800	GE	SR	M-6328 TEFC
150	720	Allis-Chal.	SR	ARHoist
250	720	L.A.	SC 4160V	OGK-BB
150	750	G.E.	SR (25 cy)	IM
125	3600	Elliott	SC 2200 V.	9NS02
125	1200	AC	SR	ARY-BB
100	900	GE	SR	MT-SB
100	1800	GE	SR	IM
100	725	Allis-Chal.	SR (25 cy.)	ARY-3 Brg.
100	900	GE	Syn 2200 V.	TS-DC Exciter
75	1200	Wagner	SC	24-W
75	900	West.	SR	CW-752C
75	600	GE	SR	IM
75	600	GE	SC 2200 V.	KT-558
60	1200	GE	SC	I-K
60(3)	1200	Allis-Chal.	SR	ARY-505 BB
60	900	AC	SC 2200 V.	ARZ-TEFC
50	1800	GE	SC	IK
50	1800	FM	SR	HV-BB
50	1200	GE	SR	MT-336
50	720	CW	SC	SC
50	600	CW	SR	SR
40	3600	GE	SC	K-405aExp.Pr.
40	1800	GE	SC	KT
40(2)	1200	Rel.&West.	SC	Fr. 445-BB
40(2)	1200	AC&Rel.	SC	TEFC-BB
40	900	West.	SR	CW
40	720	A.C.	SR	ANY
30(3)	1800	AC	SC	ARZ-TEFC
30	1200	AC	SC	ARZ-TEFC

SPECIALS

1—500 KVA Trans. West'hse Type ASL. 5% Imp. 13800/480 volts 75° Air Cooled. 2—150 KW West. M-G Sets 275 V. DC 3/60/2300 AC. 2—56RZ Falk Motoreducers 125 RPM 50 HP Class II. Hundreds other motors and electrical items in stock. Large stock new motors to 150 hp & Gearheads to 30 hp at rated discount —Freight allowed. **SEND US YOUR INQUIRIES.**

NATIONAL ELECTRIC SERVICE CO.

321 Lombard St., St. Louis 2, Mo. Phone — Chestnut 4603

MOTORS • GENERATORS • TRANSFORMERS

N.E.M.A. FRAME MOTORS

2—10 HP A.C. ARX-324 1800
1—10 HP West. CS-324 1800
1—10 HP F.M. FW-326 1170
1—15 HP G.E. K 326 1800
1—15 HP C.W. SC-A365 1170
1—20 HP L.A. X-Proof 365 1800
1—20 HP West. CS-W364 1750
1—20 HP West. CS 365 1170
2—20 HP West. CS-404 1165
1—25 HP G.E. TEFC K365 1760
1—25 HP West. CS-365 1760
1—25 HP U.S. SC-364 1800
1—25 HP G.E. TEFC KG405 1170
1—25 HP G.E. K404 1170
1—25 HP G.E. K-405 900
1—30 HP Delco TEFC-405 1745
1—40 HP West. CS-404 1800
1—50 HP Ideal TEFCBB 1800
1—50 HP G.E. K-504 1200
1—75 HP West. CS 1200
1—100 American E3 3460

1—350 KW General Electric Generators Type MPC, 250 Volt DC, 720 RPM Single Bearing Machines.

25 CYCLE MOTOR SPECIALS

1— 40 HP Reliance TEFC BB 3/25/220/440/1500 RPM.

1— 50 HP Fairbanks Morse BB 3/25/220/440/750 RPM.

1—100 HP Gen. Elect. Type KT 553 3/25/440/1445 RPM.

1—100 HP Gen Elect. Type KT 559S Ball Bearing 3/25/440/1465 RPM.

2—150 HP Gen. Elect. Type KT565 TEFC BB—3/25/440/750 RPM.

MOTORS

60-50-25 Cycle in Stock—All Sizes. Slipring—Squirrel Cage—Synchronous. All types of Control Equipment.

100 HP Gen. Electric Type I form K 3/60/2300/600 RPM.

100 HP Gen. Electric Type KT 356 3/60/2200/900 RPM.

125 HP Gen. Electric Type I form K 3/60/440/720 RPM.

125 HP G. E. Type KT 3/60/2300/1200 RPM.

150 HP G. E. Type KT 3/60/440/500 RPM.

150 HP Gen. Electric Type I form K 3/60/2300/900 RPM.

400 HP GEAR REDUCER

1—400 HP Nutall (Westinghouse) Type LMR-25 Single Helical Heavy Duty Reducer—6-1 Ratio at 900 RPM with High Speed Shaft Extension for Brake.

400 HP SYNCH. MOTOR

1—400 HP Westinghouse Synchronous Motor. 3/60/2300/900 RPM. Unity P.F. with direct connected exciter—Late Type.

55" LIFTING MAGNET

1—55" Cutler Hammer Magnet 250 Volts DC. Excellent Condition.

125 VOLT DC MOTOR

1—100 HP Crocker Wheeler 125 Volt DC 850 RPM Ball Bearing

DC CIRCUIT BREAKERS

1—1000 AMP. Condit. 2 Pole
1—1600 AMP. Condit. 2 Pole
1—1600 AMP. Westinghouse 2 Pole
1—3000 AMP. Westinghouse 2 Pole

TRANSFORMERS

1—750 KVA Niagara New. Outdoor 3/60/2400/208Y/120.
3—500 KVA Westinghouse Type SL. 1/60/33000/2400/4160Y—New 1947.
3—333 KVA Westinghouse O.I.S.C. 1/60/4800/480.
1—75 KVA Gen. Elect. Dry Type 1/60/480—240.
6—50 KVA Niagara New Dry Type 1/60/240/480—120/240.
1—20 KVA Gen. Elect. Dry Type 1/60/480—120.

ERIE ELECTRIC CO., INC. 124 CHURCH ST. BUFFALO, N. Y. CL. 4758

TAMPA ARMATURE WORKS — TAW

"Industry's Friend"

TRANSFORMERS
3 PHASE—60 CY.

1—2500 KVA 11500 to 480 Volt 3 Ph. 60 Cy. General Elec.
1—1800 KVA 6600 to 440 Volt 3 Ph. 60 Cy. General Elec.

1 PHASE—60 CY.

3—3333 KVA 66000 to 33000 & 132000 V 1 Ph. 60 Cy. Westinghouse

2—1000 KVA 13200-2300 v. 1 ph. 60 cy. Gen. Elec.
2—500 KVA 38100/66000-2300 v. 1 ph. 60 cy. Packard
2—500 KVA 38100/66000-2300 v. 1 ph. 60 cy. Gen. Elec.
4—200 KVA 33000-2300/4600 v. 1 ph. 60 cy. Pittsburg
10—100 KVA 33000-2300/4600 v. 1 ph. 60 cy. Pittsburg
3—100 KVA 33000-2300/4600 v. 1 ph. 60 cy. Allis-Ch.

BOILER FEED PUMPS

We have just acquired these two boiler feed pumps which were installed new in 1950. They are in absolutely top condition.

1—DeLaval Boiler feed pump, rated 600 GPM at 1220 ft. head. Stainless steel fitted 3 stage single suction type 250 M-3P5/4, mounted on base and originally driven by 3600 RPM motor.

1—DeLaval Boiler feed pump, identical to the one listed above except mounted on base with 233 BHP steam turbine, 400 PSIG Steam pressure, 262°F superheat, 50 PSIG discharge.

TURBO-GENERATORS

CONDENSING

1—6250 KVA 5000 KW 3600 RPM Allis Chalmers 200 lbs. 100° SH. Will operate 275 lbs. 6150 TT without change. Generator 3/60/11500. Can be changed to 2400/4160. Complete auxiliaries. Can be operated for inspection. Checked by factory engineer in Sept. 1951—no repairs required.

1—1567 KVA 1250 kw 3600 RPM Allis-Chalmers 150 lbs. Will operate 200 lbs. 450° TT without change. Generator 3/60/2300. Complete auxiliaries.

1—1250 KVA 1000 kw 3600 RPM Westinghouse 185 lbs. 100° SH 3/60/2300. Completely reworked, generator has new winding. Complete auxiliaries.

1—937 KVA 750 kw 3600 RPM Gen. Elec. 150 lbs. Generator 3/60/2300

NON-CONDENSING

1—1875 KVA 1500 KW 3600 RPM General Electric 140 lbs. turbine with type ATB 3/60/2300, 80 p.f., Synchronous Generator.

1—1250 KVA 1000 KW 3600 rpm General Electric 140 lbs. turbine with type ATB Form T 3/60/2300, 80 pf, Synchronous Generator.

1—625 KVA 500 kw 3600 rpm General Electric 175 lbs. Single stage turbine with type ATB form T 3/60/2300, 8 pt. Synchronous Generator.

1—187½ KVA 150 kw Westinghouse geared 7200/900 rpm 150 lbs. 100° SH. Generator 3/60/240.

1—125 KVA 100 kw Westinghouse geared 7200/900 rpm 150 lbs. 3/60/240

TAMPA ARMATURE WORKS INC.
401 S. MORGAN ST. TAMPA, FLORIDA PHONE 2-1966

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RE-NU-BILT BELYEA MOTORS

THE TRADE MARK WITH A MEANING SUCCESSFUL OPERATION GUARANTEED

*45th Year of Service—Member of A.R.A.**

A. C. MOTORS

3 ph. 60 Cycle

SYNCHRONOUS

Qu.	HP	Make	Type	Volts	Speed
1	—4350	Cr. Wh.		4160/13800	514
2	—3500	G. E.	TS	2300	257
1	—2500	G. E.	ATI	2300	720
2	—2100	G. E.	ATI	2300	360
2	—2000	Whse.		2300	120
1	—2000	G. E.	ATI	2200	900
2	—1750	G. E.	ATI	2300	3600
3	— 735	G. E.	ATI	2200/12000	600
1	— 500	Ideal	SM	2300/4150	1800
1	— 450	Whse.	Eng.	2200	128.5
1	— 450	Whse.		2300	450
1	— 400	G. E.	TS-6424	2200	400
2	— 350	G. E.	TS	2200	150
1	— 300	Whse.		2300	720
1	— 150	Whse.		440	600

SLIP RING

1	—1500	G. E.	MT-498	2300	360
1	—1500	ABB		2300	720
1	—1200	G. E.	MT-26	2300	275
2	—1000	A. C.	Mill	2300	240
1	—1000	G. E.	MT-452	2200	321
1	— 500	Whse.	CW	550	360
1	— 500	G. E.	M-574Y	2200	900
1	— 450	G. E.	IM	440	720
1	— 400	Whse.	CW-1218	2200	435
1	— 400	Whse.	CW	440	514
1	— 350	G. E.	MT-442	2300/4000	253
1	— 350	G. E.	IM-17A	440/2300	720
1	— 250	G. E.	MT-424Y	4000	250
1	— 250	G. E.	MT-559S	2200	1750
1	— 250	A. C.		550	600
1	— 200	Cr. Wh.	26QB	440	505
1	— 200	G. E.	IM	440	435
1	— 200	G. E.	MTP	440	1170
1	— 150 new	Whse.	CW	2300	450
1	— 150	G. E.	IM-16	440	600
2	— 125	A. C.		440	865
1	— 125	A. C.		440	720
4	— 125	G. E.	MT-566Y	440/2200	435
2	— 100	G. E.	IM	440	600
1	— 100	G. E.	IM	2200	435
4	— 100	A. C.		440	695
4	— 100	G. E.	MT	440/2200	435

SQUIRREL CAGE

2	— 650	G. E.	FT559BY	440	3750
2	— 450	Whse.	CS	2300/4150	354
1	— 200	G. E.	IK-17	440	580
3	— 200	G. E.	KT-557	440	1800
1	— 75/150	G. E.	IK	440	450/900
1	— 150	Whse.	CS	440	580
1	— 150	Westghse.	CS856S	440	880
1	— 125	Whse.	MS	440	485
2	— 125	Al. Ch.	ARW	2200	1750
2	— 100	G. E.	IK	440	580
1	— 100	G. E.	IK-Vert.	2200	450

D. C. MOTORS

Qu.	HP	Make	Type	Volts	Speed
1	—2200	G. E.	MCF	600	360/500
1	—2000	Whse.	Mill	600	230/460
1	— 940	Whse.	QM R Brg.	250	140/170
1	— 900	Whse.		250	450/550
1	— 825	Whse.	Mill	250	90/180
1	— 600	A. Ch.	Mill	230	400/800
1	— 500	Whse.	Mill	600	300/900
2	— 450	Whse.		550	415
1	— 400	G. E.	MCF	550	300/1050
1	— 300/400	G. E.	DYNA	250	1325/2500
1	— 300	Whse.	CB-5094	230	575/1150
1	— 200/300	G. E.	MPC	230	360/920
1	— 250	G. E.	MPC	230	400/500
1	— 200	Rel.	1970T	230	720
1	— 200	Whse.	CB-5113	230	400/800
1	— 150	G. E.		600	250/750
8	— 150	Cr. Wh.	83H	230	890
1	— 150	Cr. Wh.	CMC-65H	230	1150
1	— 150	Whse.	SK-201	230	360/950
1	— 150	Whse.	SK-151 B	230	900/1800
1	— 125	G. E.	MDS-416	230	415
1	— 75	C. W.	53H-TEFC	230	860
1	— 50/120	G. E.	MFC	230	250/1000
2	— 100	Whse.	SK-181	230	450/1000
4	— 60	El. Dy.	25-S	230	525/1050
2	— 50/60	Whse.	SK-170	230	400/1200
1	— 50	G. E.	CO-1810	230	725
1	— 50	Whse.	SK-170	230	350/1050
1	— 50	G. E.	RCP-343	230	1700

MOTOR GENERATOR SET

3 Ph. 60 Cycle

Qu.	KW	Make	Speed	D.C. Volts	A.C. Volts
1	3000 (3U)	G. E.	514	600	4000/13200
1	2000	G. E.	514	600	13800/4000
2	2000	G. E.	450	250	2400
1	2000(25 cy)	G. E.	500	660	6600/1100
2	1750	G. E.	514	250	2400
1	1500	G. E.	720	600	6600/13200
1	1500	C. W.	514	115	4160/13800
2	1000	Whse.	900	600	2300/4100
1	1000	G. E.	900	260	660
1	1000(3U)	G. E.	900	250	2400/4800
2	750	Whse.	900	275	2300/4160
1	750	C. W.	514	115	2300
1	600	G. E.	720	250	440/2300
1	500	Whse.	900	125/250	440
1	500	Whse.	1200	125/250	2300
1	500	G. E.	720	125	2300/4000
1	400	G. E.	720	250	440/2300
1	150	G. E.	1200	250	2300
1	150	Whse.	1200	275	2300
1	150	G.E.	1175	125	440
1	140(3U)	Cr. Wh.	690	125-250	2300
1	125	G. E.	1200	125	440
1	100	Delco	1200	125/250	440
1	100	G. E.	1200	250	2300/4000

DYNAMOMETER SPECIAL

Westinghouse—225 HP—300/2000 RPM—250 Volt Cradle type—double end taper shaft, Toledo style 9035 Beam and dial scale with electric operated strip stamping unit and tachometer generator. Only used 3/4 months.

FREQUENCY CHANGERS

Qu.	KW	Make	Cycles	Voltage
	—12500	Whse.	60/25	13200x13200
	—3000	G. E.	25/60	4000/2300x2300/4000
	—2500	G. E.	25/60	2400x4150
	—2000	G. E.	25/62½	2300x4160
	—2000	Whse.	25/62½	2300/2300
	—1000	G. E.	25/58	4400/2300
	— 500	A. C.	25/60	11000/2300V

TURBO GENERATORS

Qu.	KW	Make	Desc.
1	1000	Moore	Auto - Ext. Cond. 175/200# I.S.P. 5/20# G. Ext. Surface Condenser—3/60/2300.
1	1000	G. E.	Non-condensing 175/200 lbs. I.S.P. 5/20 lbs. G.B.P., 480/3/60.
1	750	G. E.	Condensing 425#-725#TT I.S.P. 440V. 3 ph. 60 cy.—New—1944
1	750	Whse.	—Non-condensing 135# I.S.P. 40# B.P. 750 Kw. 280 V. D.C.
1	500	Moore	Non-condensing—150/200 lbs. I.S.P. 5/35 lbs. G.B.P.—3/60/480 volts direct connected exciter.
2	500	G. E.	Non-condensing 175/200 lbs. I.S.P., 5/30 G.B.P., 480/3/60
1	300	G. E.	Non-condensing 10/175# I.S.P. 5/15# B.P. 480V. 3 ph. 60 cy.
1	200	Whse.	Non-condensing 150# I.S.P 7# B.P. 240 V. 3 ph. 60 cy.

TRANSFORMERS

60 Cycles

Qu.	KVA	Make	Type	Ph	Voltages
1	5000	Whse.	OISC	3	3300x26400/13200
1	3500	G. E.	WCT	3	13800, 6900x2300/440
1	2500	Whse.	OISC	3	26400/13200x460
3	2000	G. E.	HVDDJ	1	66000x13800
2	1750	G. E.	WCT	3	13800/6900x2300/410
3	1000	G. E.	H	1	2200x480
1	1500	G. E.	HT	3	13200x2300
3	1250	G. E.	H	1	6600x550
2	1000	Pitts.	OISC	3	2300x460
4	1000	Al. Ch.	OISC	1	2300/4000x460
3	1000	Wagner	OISC	1	13200x220/440
1	300	Kuhl	OISC	3	13800x460
3	200	Whse.	OI5C	1	13200x120/240
1	150	G. E.	HT	3	25000x120/208
3	150	Whse.	OISC	1	33000x2300/400
2	75	Upte	OISC	3	4160x24

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OFFICE AND SHOP

43 HOWELL ST., JERSEY CITY 6, N. J.

PHONE JO 2-3334 — N. Y. CITY LINE RE 2-7150

SLIP RING MOTORS 3-Ph., 60 Cy.

H.P.	Volts	Make	Speed
600	440	Whse.	1800
600	2200	Whse.	450
500	440/220	Whse.	720
500	2200/4000	G. E.	900
450	440	Whse.	514
350	4000/2300	Whse.	1800
300	2200/440	G. E.	720
300	440	G. E. (hoist)	600
300	2200/440	Whse. (new)	600
300	2200	G. E.	360
300	440	Whse.	3600
250	440/220	Whse.	600
250	550/440	G. E.	1200
250	440	G. E.	600
200	440/220	Whse.	514
200	440	G. E.	450
150 (2)	440/220	G. E.	720
150	2200/440	G. E.	600
150	550/220	G. E.	720
145	4000/2300	G. E.	1800
135	440/220	G. E. (hoist)	600
125	440/220	G. E.	900
125	550/440	G. E.	1200
125	2200	G. E.	600

SYNCHRONOUS MOTORS 3-Ph., 60 Cy.

H.P.	Volts	Make	Type	R.P.M.
400	2200/440	G. E.	ATI	720
350	440/220	El. Mchy.	Syn.	1200
350	440/220	Whse.	HR	900
300	2300/400	G. E.	TS	720
300	2300/440	G. E.	TS	720
250	440/220	Whse.	HR	277
250	2200/440	G. E.	TS	1200
250	440/220	G. E.	ATI	600
250	2300/440	G. E.	ATI	720
225	440/220	Whse.	HR	360
200	4150/2300	Whse.	G	1800
125	440/220	Whse.	HR	400
120	440/220	G. E.	ATI	900
110	440/220	G. E.	TS	257

SQUIRREL CAGE MOTORS

H.P.	Volts	Make	Type	Speed
600	2200	G. E.	FT	3600
500	2200	Whse.	CS	514
500	2200/4000	Elliot	SC	1800
400	2200/400	Whse.	CS	720
300	2200	L. Allis	FS	1800
300	2200	G. E.	FT	3600
250	2200/440	G. E.	TK	720
225 (2)	2200/440	G. E.	KT	1200
200	2200/440	G. E.	K	1200
200	440	G. E.	TK	720
200	440	G. E.	TK	514
200	440/220	G. E.	KT	1800
200	2200/440	G. E.	JK	600
150	2200	Al. Chal.	AR	1800
150	220	Whse.	CS	1200
150	440	Multi sp.	KT	1800/600
150	440/220	G. E.	TK	450
150	440/220	G. E.	KT	720
150	440/220	Howell	B. Brg.	1800
150	440/2200	G. E.	TK	514
150	2200/440	G. E.	KT	600
125	440/220	G. E.	KT (vert.)	1200
100	2200/440	G. E.	K	1200
100	220/440	G. E.	K-TEFC	720
60 (2)	2200	Whse.	CS X-rf.	1800
50 (2)	410/220	Whse.	CS-TEFC	1800
50	220	Al. Chal.	X-prf.	600/1200

A. C. GENERATORS

1—320 kva. 660 rpm 2300/440/220 V., G. E.
1—250—kva. 720 rpm. 2300/440 V., G. E.
1—225 kva. 600 rpm. 220/440 V., G. E.
1—200 kva. 720 rpm. 2200/440 V., G. E. (Ball brg.)
1—187 kva. 1200 rpm. 2200/440 V., Whse.

CIRCUIT BREAKERS

2—2000 amp. GG E., 3 pole, 600 V.
2—1600 amp. ITE, 3 pole, 600 V.
6—FKR-155-28, 600 amp., 15,000 V., G.E., Sol. oper., draw-out.

D. C. MOTORS

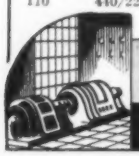
H.P.	Volts	Make	Type	Speed
250	230 (2 new)	Cr. Wh.	CMC	1800
250	230 (2)	G. E.	CD	1750
150	230	Whse.	SK	850
100	230	Cr. Wh.	CMC	625
90	230	G. E.	CD	1750
80	230	G. E.	RC	600
50	230	Rel.	T	400/1200

MOTOR GENERATOR SETS

KW	Make	Input V., AC	Motor Type	Output V., DC
250	Whse.	2200	Syn.	250
175	G. E.	220/440	Syn.	230
150	Whse.	440	sq. ca.	250
100	Al. Ch.	220/440	sq. ca.	240/120
100	Whse.	440/220	sq. ca.	125
75	G. E.	2200/440	Syn.	125
65	G. E.	2200/440	sq. ca.	250
65	G. E.	2200/440	sq. ca.	125
60	G. E.	440/220	sq. ca.	250/125
45	G. E.	440/220	sq. ca.	250
40	G. E.	440/220	sq. ca.	250/125

TRANSFORMERS 60 Cy.

1—600 kva. Standard, 13,800-2300 V., 3 ph.
3—200 kva. G. E., 11000—2300 V.
3—200 kva. G. E., 4150—480/240 V.
3—150 kva. G. E., 33000—2300/4600 V.
3—150 kva. Al. Chal., 2400—240/480 V.
3—150 kva. Al. Chal., 2400—240/120 V.
3—100 kva. Whse., 2400—240/480 V.
6—100 kva. Whse., 2400—120/240 V.
5—100 kva. G. E., 4150—120/240 V.
2—100 kva. Whse., 2400—120/55 V.
3—75 kva. Whse., 2400—240/480 V.
3—75 kva. Moloney, 4150—240 V.
3—50 kva. Whse., 440—220/110 V.
6—50 kva. G. E., 2400—120/240 V.
11—50 kva. Whse., 2300-110/220 V., dry



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LAND'S 44th YEAR
MOTORS & GENERATORS, etc.
1 YEAR GUARANTEE

125 VOLT DC GENERATORS

KW	Make	Speed
150	Westg. (2)	1200
100	Cr. Wh.	1200
100	E.M.	1200
100	G. E. (2)	900
100	Westg.	1200
100	Westg. (2)	900
75	G. E. (2)	1200
60	Westg.	1750
50	Cr. Wh.	1160
50	G. E.	1150
50	Westg. (2)	1150
40	G. E. 3-unit	1150

PLUS 40 additional units ½ to 40 KW

250 VOLT DC GENERATORS

KW	Make	Speed
2000	G. E.	NEW
1150	G. E.	NEW
1000	A-C	720
250	Cr. Wh.	1200
200	G. E.	1200
150	Westg.	900
125	G. E. (3)	1200
125	E. D.	1750
100	Delco (4)	1150
75	Westg.	900
75	Cr. Wh.	1150
60	N. W.	1150
40	Rel.	1750
40	G. E. 3-Unit	1150
25	G. E.	1200
17	A-C	1750
15	Star	1750
10	G. E.	1150

PLUS 15 additional units ½ KW to 7½ KW

SLIPRING MOTORS

HP	Make	Speed
600	C. W.	514
500	G. E.	600
500	G. E. (2)	450
450	G. E. (2)	880
350	Westg.	435
300	Westg.	1150
250	G. E.	600
200	G. E.	1750
200	Westg.	600

Partial Listing Only!

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1—125 KVA GE AC 3/60 220 Volts/1200 RPM
1—250 KVA Elliott AC 3/60 220 Volts/1200 RPM
4—500 KW West. DC/120-240 Volts 1200 RPM

DIESEL ENGINES & GENERATING SETS

6—G.M. Quads (Navy Re-processed)
10—Unused GM Twins
2—Hamilton 600 HP 720 RPM w/Dir. Con. Blowers Air Start Dir. Rev. Mfg. 1942
3—GM 8-268A w/100 KW West. AC/440V/1200 (WILL SELL PARTS & GENS. SEP.)
1—G.M. 8-268A 500 HP Marine Propulsion Engine w/rev. reduction gear & access. excell.
1—Copper-Gessemer FS8 500 HP 900 RPM
* 2—Hercules DWXD w/Heat Exch. & Clutch
1—Worth. DD8 w/500 KW GE 3/60/2300V
* 1—GM 8-268A w/200 KW West. 3/60/440V/1200
1—100 KW Larimer 3 ph 440 V. Diesel Set
1—90 KW Cummins 3 ph 220 V. Diesel Set
8—30 KW Buda 3 ph. 4 wire Diesel Sets
1—30 KW Int. Har. 3 ph 4 wire Diesel Set
1—15 KW Int. Har. 3 ph 4 wire Diesel Set
2—20 KW Le Roi 1 ph 120/240 V. gas gen. sets

SYNCHRONOUS MOTORS

** 4— 75 HP Burke 3/60/220-440V/1800
** 2—125 HP El. Mach. 3/60/4800V/900
15—135 HP GE 3/60/4000 V/1200 TS963Z
* ** 1—200 HP El. Mach. 3/60/208V/1200

AC & DC GENERATORS

* ** 25—3 KW GE 3/60/120-208V/1800 w/Panels
* ** 35—5 KW 1 & 3/60/120-208V/1800/1BRG
* ** 20—10 KW GE 3/60/120-208V/1800/ w/Panels
* ** 8—25 KVA GE 3/60/440V/1800
2—56 KVA Star 3/60/120-208V/1200—B.B.
1—75 KVA El. Mach. 3/60/440V/900
2—500 KVA El. Mach. 3/60/440V/900 2 Brg.
** 4—25 KW West. DC 125V/1800 2 Brg.
4—500 KW West. DC 120-240V/1200

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MOTORS · MG SETS

All guaranteed for one year.

Qty.	HP	Make	Voltage	Speed
12	3000	West.	525/600	600 RPM
26	1500	West.	525/600	600 RPM
32	1500	Al. Ch.	525/600	675 RPM
4	1200	Al. Ch.	525/600	650 RPM
2	900	Elliott	230	300/195 RPM
3	800	West.	525/600	600/900 RPM
1	650	Cr. Wh.	230	475/720 RPM
1	500	West.	230	250/500 RPM
1	400	G. E.	230	180/360 RPM
7	400	Elliott (new)	230	400/800 RPM
5	400	West. (new)	230	375/750 RPM
2	350	Cr. Wh.	230	400/800 RPM
1	200	Cr. Wh.	230	500/750 RPM
1	200	Cr. Wh.	230	375/750 RPM

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100 HP Slip Rg. Motors—900—720 & 450 RPM

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1—1000 KW West. 250 volt Flat Compound 500 RPM 1440 H.P. West. Syn. Mtr. .8 P.F. 3/25 cycle 2300 V. A.C. & D.C. Panels
1—500 KW Crocker Wheeler CCD, 250 volt 720 RPM with 750 KVA Cr. Wh. Syn. Motor 3/60/2300 V. A.C. & D.C. Panels.
1—300 KW West. 3 wire 125/250 Volt 1200 RPM Generator (1938 year). Can furnish with suitable motor. Advise Requirement.
2—250 KW Burke 125 V. 435 KVA Syn. M.D. 3/60—any voltage
1—150 KW G.E. Type MPC—250 Volt 1200 RPM 3/60/2300/200 H.P. Syn. Motor Drive A.C. & D.C. Panels
100 KW Electro Dynamic 200 V. 3/60/220/1200 B. Brg. Sq. Cg. Sep. Excited.
1—100 KW Al. Ch. 250 V. 1200 RPM 150 HP. Syn. Mtr. 2/60 or 3/60 any voltage.
1—75 KW Burke 250 V. 900 RPM 113 H.P. Burke—Syn. M.D. 2 or 3 ph. any voltage.
1—62½ KW 125 volt Hertner, 1200 rpm, 100 HP Sq. Cg. 3/60/220
2—50 KW GE 500 Volt DC, 75 HP, 3/60/40/1200 RPM.
Smaller Sizes and Types—Advise Requirements

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1—450 HP Keeler CP 160 lb. Oil
1—300 HP Keeler CP 300 lb. Oil
1—250 HP B & W 250 lb. 1948
2—200 HP Springfield Sec. Hdr. 400 psi.
1— 80 HP Cleaver Brooks Package 125 psi.
1— 60 HP Cylcotherm Package 125 psi.
1— 25 HP Dowtherm Vaporizer

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1—1250 KVA Nordberg 3/60/2300/360 RPM 1940
1—375 KVA GM 8-268A, 3/60/480/1200 RPM
1—250 KVA G.M. Twin 6-71, 3/60/220/440/1200 RPM Rad. Cooled.
1—187 KVA G.M. Twin 6-71 Portable, 3/60/220/440 New
1—125 KVA Cooper Bessemer 8 cyl. 900 rpm 3/60/220 Elec. Start.
2— 45 KVA Chry. New 6 Cyl. 3/60/220/440.
1—200 KW G.M. Twin 6-71, 240 D.C. Rad. Cooled Elec. Start.

ELECTRIC MOTORS

Qu.	HP	Make	Type	Volts	Speed
1	1500	Al. Ch.	sl. rg.	2300	514
1	1000	G.E.	K	2300	1800
1	1000	West.	CW	2300	450
1	700	West.	CS	2300	1800
1	500	Al. Ch.	Syn.	2300	212
1	500	AC	ARX	2300	1800
1	500	West.	CS	6600/2300	514
1	450	A.C.	ANY	2300	600
1	400	West.	CW	440	514
1	400	G.E.	Syn.	2300	450
1	350	G.E.	MT18	2300	400
2	200	G.E.	KT559	2200	1200
1	200	West.	CW	440	1800
1	200	G.E.	IM	440	600
1	125	West.	Syn. 3 brg.	550	600
2	100	G.E.	KT352	220/440	1200
1	50	West.	CS	440	3600
1	50	West.	CS	440	1200

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New O'Brien mfrd. Red Line dry type Transformers to 150 KVA single phase, 300 KVA, 3 phase—4800 V. Pri.—& Phase Changers to 100 KVA.

TURBO GENERATORS
Philadelphia Stock

1—2500 KVA West. Cond. New 1936. 3/60/2400 —200 psi Surf. Cond.
1—1250 KVA DeLaval Non-Cond. 3/60/2300. New 1940 240 psi 50 lb. B.P.
1—938 KVA GE-Terry Aut. Extr. 3/60/480 150 psi. 20 lb. B.P. Surf. Condenser 1934
1—780 KVA G.E.-Moore 3/60/2300/3600 RPM Non-Cond. 180 PSI 35 lb. B.P. New 1936.
1—187 KVA West. Non-Cond. New 1930 3/60/440 110 psi 10 lb. B.P.
1—94 KVA Worthington Non-Cond. 3/60/220 140 psi 5 lb. B.P.
1—75 KW G.E. Non-Cond. D.C. 125 volt.

AIR COMPRESSORS

1—1600 CFM Sullivan WJ 8 Angle Cpd. 100 psi 22/13x16 belt.
1—1000 CFM Chicago OCE Syn. Mtr. Dr. 175 HP 3/60/2300.
1—978 CFM Sullivan 13x13x8, 45 psi.
1—215 CFM Penna 3A, 70 psi—V-Belt.
1—368 CFM Chi. NSB, 12x10, 100 psi.
1—371 CFM Schramm 7⅛x5x4, 100 psi
2—22 CFM Curtis 3 Stg. 1500 psi; V-belt

OISC TRANSFORMERS

Qu.	KVA	Make	Pri. V.	Sec. V.	Phase
2	1000	West.	33000	460	3
3	1000	GE	13200	2300	1
1	1100	West.	4160	440	3
3	667	Al. Ch.	33000	2300	1
3	500	West. Dry	33000	2300	1
3	500	West.	22000	460	1
1	500	Gregory	4160	440	3
3	500	GE	13200	2300	1
3	400	GE	2400	480	1
3	333	West. Dry	2400	480	1
3	333	Pitts.	33000	2300	1
3	333	G.E.	13800	240/480	1
3	150	West.	2300	230/115	1
3	150	Dry	2300/4160	230/460	1
3	100	Dry	2300/4160	230/460	1

1—New O'Brien "Red-Line" 750 KVA OISC Transformer 13,200/13,800 v. pri., 480 v., sec., 3 ph.
3—333 KVA New O'Brien Red Line O.I.S.C. Transformers 4160 V primary 480 V secondary ea. single ph. 60 cyc.

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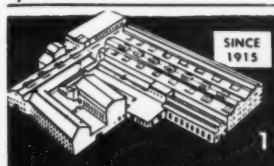

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Discounts from 60% to 65% Off on Motors listed below.

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(2G Label) 220-440 volts

Amt.	HP	Speed	Make	Frame
1	30	1500	Rel.	445
1	25	1500	Rel.	405
1	15	1500	L.A.	405S
1	15	1500	G.E. (open)	404
3	10	1500	L.A.	364
3	5	1500	L.A.	284
1	5	1500	L.A. I-D	284

1/60/115-230 (1-D Label)

4	3	1800	L.A.	254
1	1½	1800	L.A.	225
1	1½	1200	G.E.	225
6	1	1800	L.A.	224

1/60/115/230 OPEN DRIP-PROOF

26	1	1800	L.A.	204
7	1	1800	Std. D.	203

2/60/220-440 OPEN DRIP-PROOF

1	7½	900	L.A.	326
2	5	1200	L.A.	284
2	1½	1200	L.A.	224
4	1	3600	L.A.	163
2	1	1800	L.A.	203

3/60/550—OPEN DRIP-PROOF

1	100	3600	G.E.	447S
13	40	3600	Rel.	4018
1	25	3600	G.E.	3618
5	5	3600	L.A. XP	225

NEW MOTOR STARTERS

6—Size 3 Allen-Bradley, XP-2G Label Bul. 709
1—Size 3 Whse. Combination, Circuit breaker, Nema 1, 3/60/440
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100—Size 1 NEW Whse. life line 3/60/220

3/60/220 GEARMOTORS

3—10 HP, 55 RPM, Whse. FR. 324, Parallel Shaft Output
17—NEW Cleveland right angle worm gear reducers rated 5 HP—1150 RPM, 7.5 HP—1750 RPM, 6-1 Ration, Series 215—50 RT Class 1
4—Ratio 10-1; series 25F—ditto

230 V DC

1	10	1200	Whse.	8K63
4	7½	1200	Elec. Dy.	324

10,000 Other Motors in Stock
FHP Thru 1000 HP. New and Rebuilt

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All Motors in Original Crates

230 VOLT

Amt	Hp	Speed	Make	Type	Frame	Wind-ing
4	40	1140	Star	2CA0545-3		Sh
3	30	1750	GE	CDM	85	Sh
1	30	1750	GE	CD TEFC	95	Sh
6	30	1750	Westgh	SK	93	Sh
1	30	1150	Cent			Sh
1	30	850	GE	CDM	1126	Comp
2	25	1750	Westgh	SK	103	Sh
1	25	1750	GE			Sh
10	20	2590/3450	L.A.	OGNA	3261	Sh
2	20	2590/3450	N'wstn	CD	75	Sh
1	15	1500	GE	CDM	83	Sh
1	10	1750	Cent	DN	324	Sh
1	10	1225/1750	Westgh	SK	63	Sh
1	10	1750	GE	CDM	66	Sh
1	10	1200	GE	CDM	67	Sh
1	10	850	GE	CDM	75	Series Dbl end
2	7½	1750	Rel	23T		Sh
5	7½	1750	F & M	DZS	LA284	Sh
4	7½	1750	GE	SK	284	Sh
1	7½	1750	L. A.	NA		
5	7½	1750	Westgh	SK	44	Sh
11	7½	1150	Imp	D	D26	Sh
3	7½	1150	GE	CDM	66	Comp
9	7½	850	GE	CD	75	Sh
1	2½ to 5 KW	575/1150	E. Dyn		D328	Sh
1	5	1700	Rel	23T		Sh
1	5	1250	GE	B	254	Sh
3	5	1150	GE	B	284	Sh
2	5	850	GE	CDM	66	Sh
2	5	850	Imp	D	D242	Comp
2	3	1850	Westgh	SK	284	Sh
3	3	1750	Cent	DN	225	Sh
1	3	1750	GE	B	225	Sh
1	3	1750	Kimble	BA	225	Comp
1	3	1750	Star	2C00-2250		Sh
2	3	1150	F & M	DZ D	LB254	Sh
2	3	850	GE	B	284	Comp
5	3	850	GE	B	284	Sh
1	3	850	E. Dyn		D284	Sh

Amt	Hp	Speed	Make	Type	Frame	Wind-ing
6	2	1750	Westgh	SK	225	Sh
12	2	1750	GE	B	224	Sh
4	2	1750	Rel		225	Sh
6	2	1150	GE	B	225	Sh
1	2	1150	Westgh	SK	254	Sh
12	2	850	GE	B	254	Sh
12	1½	1750	L. A.	GNA	224	Sh
1	1½	850/1750	Westgh	SK	254	Sh
1	1½	1200	GE	B	224	Sh
12	1½	850	GE	B	254	Sh
3	1	1150	GE	B	204	Sh
4	1	850	GE	B	225	Sh
4	1	1750	Star	2C00	204	Sh
1	1	1750	Al. Ch.	EB 50		Sh

115 VOLT

2	40	1750	GE	CDM	93	Sh
1	30	1140	Star	2CAE-516		Sh
2	7½	1750	N'west	4E4½		Comp
1	7½	1750	Crock	WH CCM		Comp
4	5	1750	Westgh	SK	225	Comp
3	2	1750	B-Line	DM	225	
1	1	1150	GE	B	204	Comp

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37 Star Gearmotor, 7½ HP, 1750 RPM, type 5G-284-5-6, compound, 30 minute duty, W/GE. Model B2818156, ratio 11.5 to 1.

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1—1100 GPM 220' Allis-Ch. Cent. Pump
1—1080 GPM 280' all-bronze Cent. Pump
1—750 GPM 231' Pump with 75 HP 3 ph. Motor
2—600 GPM 360' Pump with 72 HP Turbines
1—200 GPM 556' Pump with 50 HP Turbine
1—Kinney unused 6" Rotary Pump, 450 GPM
3—Blackmer 6" Rotary Pumps, 500 GPM
3—750 & 1000 GPM Knowles Steam Fire Pumps
1—8"x10" & 1—7"x8" Triplex Pumps
1—3"x8" Galland Hydraulic Triplex Pump
1—12"x14" Duplex Air Compressor, 850 CFM
1—12"x10" I-R Air Compressor, 355 CFM
2—12"x9" Worth. Comp. 375 CFM Vac. & Press.
1—4-stage Norwalk Compressor 28 CFM 5000 PSI
1—GE Turbo-Blower 8500 CFM 16 oz., 58 H.P.
1—Sturtev. Turbo-Blower 7000 CFM 20 oz., 60 HP
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1—US Hoffman 25 HP Turbo—1500 CFM—2 PSI
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1—Beach-Russ No. 7 Vacuum Pump, 110 CFM
1—GE 2-stage Turbo-Blower 3000 CFM 16 PSI
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3 Phase, 60 Cycle

Qu.	H.P.	Make	Type	Volts	R.P.M.
1	400	Cont.	NZ-806-S	2300	1200
1	400	G. E.	I-K	2200	514
1	300	Whse.	CS-890	2300	1750
1	200	Whse.	CS-873-C	2200	1160
1	200	Al. Ch.	AR	440/220	580
2	125	Al. Ch.	AR	2300	1750
1	125	Al. Ch.	AR	2300	490
1	100	Whse.	CS-663-C	440	1750
1	100	G. E.	KT-562	440/220	570
1	100	Whse.	CS-938	2200	495
1	100	F. M.	H-241B	440	435

MOTOR GENERATOR SETS

Qu.	KW	Make	RPM	V. DC	V. AC
1(3U)	2100	Whse.	720	600	4800/2400
2	1100	Whse.	720	600	2300
3	1000	Whse.	514	600	11000/6600
1(3U)	500	Whse.	1200	125/250	440/2300
2	500	C. W.	720	575	2300
1	400	C. W.	720	250	2300
1	400	C. W.	1200	125/250	440/2300
1	300	Whse.	1200	275	2200
1	250	Whse.	1200	125/250	440/2300
1	200	Whse.	1200	275	4000/2300
1	200	Whse.	1200	125/250	4000/2300
1	200	Whse.	1200	600	4000/2300
2	150	Whse.	1200	125/250	440
1	155	G. E.	720	250	2300/440
1	100	Ridgeway	1200	275	4000/2300
1	100	C. W.	1200	125	440/220
1	85	C. W.	1200	250	4000/2200
1	75	Al. Ch.	900	250	2300
1	25	Ideal	1750	125	440/220
2	25	Al. Ch.	1200	250	440/220
3	20	Al. Ch.	1200	250	440/220

Any of these sets can be furnished with D.C. panels and starting equipment.

SLIP RING MOTORS
Constant Duty, 3 Phase, 60 Cycle Type

Qu.	H.P.	Make	Type	Volts	R.P.M.
1**	1800	G. E.	MT-498	2300	357
1**	1200	G. E.	MT-26	2200	277
2	800	G. E.	MT	2200	440
1	700	G. E.	I-M	2300	400
1**	600	G. E.	MT-30	2300	360
1**	500	Al. Ch.	ANY	2200	514
2	500	G. E.	I-16-M	2300	450
2	400	G. E.	MT-412	2200	450
1	250	Whse.	CW-937	440	1209
1	250	G. E.	MT-414	2200	300
1	250	Al. Ch.	ARY	440	720
2	100	G. E.	I-15-M	2300	514

**—Pedestal bearing design.

SYNCHRONOUS MOTORS
3 Phase, 60 Cycle

Qu.	H.P.	Make	P.F.	Volts	R.P.M.
1	4350	C. W.	80	13200/6600	514
1	3000	Whse.	80	4800/2400	720
2	2100	G. E.	100	2300	360
2	2000	G. E.	80	2300	720
2	1750	G. E.	100	2200	3600
1	750	G. E.	80	2300	450
1	710	G. E.	80	2300	720
2	600	G. E.	80	2300	600
1	250	G. E.	100	2300	514
2	200	Whse.	80	440	1200
1	187	G. E.	80	440	720
1	150	G. E.	100	2200	900
1	150	G. E.	100	550	600
1	150	Whse.	80	440/220	450
2	135	G. E.	80	4000/2200	1200
3	125	El. Mchy.	100	4800/2400	900
1	125	G. E.	8	2200	900
2	100	Whse.	8	440	1800
1	100	Ideal	8	440/220	900
2	100	G. E.	8	440/220	600

We have a large stock of manual magnetic and semi-magnetic, reduced and full voltage control for use with these motors.

DIRECT CURRENT MOTORS
Variable Speed (230-VDC)

Qu.	H.P.	Make	Type	R.P.M.
1	200/250	G. E.	MPC	300/ 900
1	200/250	El. Dy.	No. 22	400/1200
1	90/160	G. E.	MPC	625/1125
1	60	El. Dy.	25-8	450/ 900
1	50	Whse.	SK	250/1000
1	40	Whse.	SK-140	500/1000
1	35	G. E.	CD-125	400/1200
1	35	G. E.	CD-147	300/1200
1	32½	Whse.	SK-150	400/1200
1	30	G. E.	CDM-105	875/1750
1	25	Whse.	SK-123	500/1500
1	25	Whse.	SK-140	400/1200
1	25	Whse.	SK-111L	250/1000

Constant Speed (230 Volt)

Qu.	H.P.	Make	Type	R.P.M.
1	350	G. E.	CD-169-A	1150
1	180	G. E.	MPC	400
2	125	Whse.	SK-184	575/ 850
1	30	Whse.	SK-110	1800
1	25	Whse.	SK-103	1150
1	25	Whse.	SK-113	950

TRANSFORMERS 60 CY.
Outdoor—Oil Cooled

Qu.	KVA	Make	Phase	Voltage
1	5000	Pitts.	3	13,200-4600
1	4500	G. E.	3	27,000/24,300-2300 Δ
1	2750	G. E.	3	14,000/13,200-240/480
1	2750	G. E.	3	14,000/13,200-2300/4160
3	1250	G. E.	1	26,400/13,200-2400/4150
3	750	Pitts.	1	27,000/24,300-2300/4000
3	500	G. E.	1	4800- 240/ 480
3	333	Pitts.	1	22,000/11,000-2300
3	150	Al. Ch.	1	7200/ 4160- 240/480

(6)—Allis-Chalmers metal-clad cubicles, each complete with 1200 amps., 15,000-Volt drawout O.C.B., type DZ-200A, 500,000 int. capacity, motor operated lifting mechanism, Relays meters, etc.

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COMPLETE DIESEL PLANT

3—Fairbanks Morse units. 805 HP—556 KW; 690 HP—473 KW; 300 HP—200 KW. Model 33-E-14. 3/60/2400 volts. New 1940. Will sell all or part. With auxiliaries. Condition excellent.

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POWER PLANT EQUIPMENT
SPECIAL OFFERINGS

TURBO-GENERATORS
1—20,000 KW 200# 13,200 V.
1—10,000 KW 200# 13,800 V.
1— 5,000 KW 275# 11,500 V.
1— 4,000 KW 400# 2300 V.
1— 3,000 KW 425# 13,200 V. Ext/170# Non Cond.
1— 3,000 KW 175# 550 V. Cd.
1— 1,500 KW 150# 2300 V. Cd.
1— 1,500 KW 175# 550 V. Ext.
1— 1,000 KW 250# 480 V. Ext.
1— 1,000 KW 200# 4160 V. N.C. NEW 1949.
2— 750 KW 150# 250 V. D.C.
1— 500 KW 200# 4160 V. N.C.
1— 300 KW 125# 250 V. D.C.
2— 120 KW 150# 240 V. N.C.

DIESEL GENERATORS
1—1000 KVA 2400 volts
1— 200 KW 250 V. D.C.
1— 400 KW 480 volts
1— 300 KW 2400 volts
2— 75 KW 240/480 V.

BOILERS
2—50,000# 275# (1949)
3—15,000# 275# (1945)
1—400 HP Sec. Hd. 225#
1—300 H.P. 300# (1948)
1—84" HRT 150# (1942)

DEAERTING HEATER
1—85,000# Never Used

Write or wire for additional data and prints.

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Stepless speed variation with constant speed prime mover made by American Blower Co.
Ideal for pumping stations, steel mill drives, mechanical draft fans, crushers, rotary kilns, etc.
Wide range of capacities—Condition 98% new
200 HP to 2500 HP Input
300 RPM to 900 RPM Input
Complete data & quotation on request.
Also large selection of marine couplings, reduction gears, & Falk grid type couplings in stock.

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We rewind, repair and redesign all makes and sizes.
One Year Guarantee.

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2 SYNCHRONOUS MOTORS
1000 to 1500 HP, 300 RPM, for 4160 volt, 3 phase, 60 cycle, AC. When offering, include complete nameplate data including serial numbers. Write
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POWER EQUIPMENT

TURBINE UNITS

1—5000 KVA G.E. 3/60/2300/4000 V. 3600 RPM STRAIGHT CONDENSING nozzled for 450 psig 750° TT Surface Condenser.

1—1250 KVA Al. Ch. 3/60/480 V. 3600 RPM. Terry EXTRACTION turbine nozzled 250 psig 550° TT 40,000# extr. 25 psig. Surf. Cond.

1—938 KVA West. 3/60/480 V. 3600 RPM Terry EXTRACTION turbine nozzled 250 psig 500° TT 10,000# extr. 50 psig. Surf. Cond.

1—375 KVA G.E. 3/60/480 V. 3600 RPM. NON-CONDENSING nozzled for 150 psig, 5-10 psig back pressure.

BOILERS

1—50,000# Edgemoor bent tube 225# WP 490° TT Coxe chain grate stoker and economizer. New 1939.

2—502 HP Heine water leg type 200# WP 480° TT Coxe chain grate stokers. New 1929.

DIESEL & GAS ENGINE UNITS

1—1600 HP Fair. Morse 2300/4150 V. 60 cy.
1— 275 HP Ing. Rand. 240 V. 60 cy. (Gas)
1— 250 HP Buckeye 240 V. 60 cy.

MOTOR GENERATOR SETS—60 CY.

QU.	KW	MFR.	V.—DC	A.C.	RPM
1	3000	G.E.	250	13200	514
1	1500	G.E.	600	4150	600
2	1000	West.	650	4150	900
1	200	West.	275	2200	900
2	150	G.E.	250	2300	1200
1	75	Ridgway	125	220	1200

SYNCHRONOUS MOTORS

QU.	HP	MFR.	VOLTAGE	RPM
2	2000	West.	13200	1200
1	900	A.C.	2200	180
2	700	West.	2300	600
1	600	G.E.	2300	240
1	300	G.E.	2300	600
1	300	West.	2300	900
1	200	G.E.	2300	900

FREQUENCY CHANGERS

QU.	KVA	MFR.	CYCLES	RPM
1	12500	G.E.	25/60	300
1	3750	G.E.	25/60	300
1	3125	G.E.	25/60	300
1	2500	G.E.	25/62½	750
1	1875	A.C.	60/25	300
1	500	G.E.	25/62½	750

OIL CIRCUIT BREAKERS—Outdoor

4— 800 A. 132 KV West. G-222A-2500-M /A
1— 400 A. 73 KV Condit FO-40-250 MVA
2— 400 A. 37 KV G.E. FHKO-136-350 MVA
4— 600 A. 15 KV G.E. FHKO-139-750 MVA
1—1200 A. 15 KV G.E. FKO-139-350 MVA
7— 600 A. 15 KV G.E. FK-155-28-350 MVA I/D

TRANSFORMERS

4—	2500 KVA Mel.	69000—13800
4—	500 KVA West.	69000—6900
3—	400 KVA G.E.	66000/33000—2300/4160
3—	1250 KVA A.C.	44000/11500—460
3—	150 KVA Mel.	44000—2400/7200
3—	75 KVA West.	44000—7200/12470
4—	5000 KVA G.E.	40935/70900 Y—14500
3—	3333 KVA G.E.	33000/11000—2400/7200
3—	333 KVA G.E.	33000—7200/12470 Y
3—	200 KVA A.C.	33000—2400/7200/12470
3—	75 KVA Wag.	33000—7200/12470 Y
3—	1250 KVA G.E.	26400/13200—2400
4—	1500 KVA A.C.	25400/44000—6900/13800
4—	450 KVA A.C.	25410/44000—13280/23000
3—	1000 KVA Mel.	22000—2300
3—	100 KVA G.E.	22000—7200/12470 Y
1—	3000 KVA Stand.	19050/33000—4160, 3 ph.
1—	600 KVA Stand.	13200—2300, 3 ph.
1—	450 KVA Penn.	13200—2400, 3 ph.
3—	200 KVA G.E.	13800—2300
3—	250 KVA Pitts.	7200—220/440
3—	100 KVA G.E.	7200—240/480
3—	150 KVA Wag.	6900—2300
3—	37½ KVA G.E.	6900—230/460
3—	150 KVA Wag.	4800/2400—240/120
3—	333 KVA G.E.	2300—230/460
3—	250 KVA G.E.	2300/4000 Y—115/230
3—	200 KVA West.	2400—240/480
3—	150 KVA West.	2400—230/115
1—	100 KVA G.E.	2300—575, 3 ph.
3—	75 KVA A.C.	2400—240/480
6—	50 KVA West.	2400—114/228 Dry Type

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(6) OIL FIRED B&W BOILERS

Cross Drum Sinuous Headed straight tube type. Heating surface 11417 sq. ft.—1141.7 HP—210 P.S.I.G. design pressure—200 P.S.I.G. working pressure—75,000 lbs./hr. capacity—steam temp., saturated—1024 cu. ft. furnace volume —200° feed water temperature.

(2) B&W WATER TUBE BOILERS

ASME code—from ATR tug—built 1943. 15,000 lbs. steam/hr./unit (normal) 18,000 lbs. steam/hr/unit max. Design pressure—268 lbs/sq. in. —total steam at drum outlet (saturated) 409 —forced draft—turbine driven blowers—1508 sq. ft. boiler heating surface. Gas or oil.

(4) 300 KW G.M. 8-268A DIESEL GEN.

G.M. diesel generator sets—120/240 volts DC —1200 RPM—1250 amps.—8 cyl. 6½x7—with switchgear.

(2) 60 KW CUMMINS DIESEL GEN.

120/240 volts DC—250 amps.—Model H engine —6 cylinder—heat exchanger cooled.

(2) 100 KW GM 3-268A 440/60/3 AC generator sets.

(1) 100 KW LORIMER 440/60/3 AC generator set.

(1) 100 KW FAIRBANKS-MORSE opposed 440/60/3 AC generator set.

75 KW WAUKESHA DIESEL GEN.

Heavy duty—totally enclosed—with built-in switchgear. 75 KW — 230 volts DC. 6 cyl. Waukesha diesel, 160 HP, 1200 RPM. Radiator cooled.

(6) 300 KW TURBO GENERATOR SETS

120/240 volts DC—Joshua-Hendy turbine—250 lb. W.P. condensing. Suitable for pressures to 440 lbs. at 740°TT. Geared to 1200 RPM. 300 KW Westinghouse 120/240 volt 1250 amp. stablized shunt generator. With switchgear. Built 1945. Excellent condition.

(1) SUPERIOR HEAVY DUTY DIESEL

510 HP at 360 RPM—5 cylinder—14½x8—type ZDSB—non-reversing—vertical—4 cycle—cold starting—mechanical injection. Engine totally enclosed. For heavy duty pumping, dredge service, power generation, textile & saw mills, etc. Excellent condition. Immediate delivery.

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50 HP—230 volts DC—built in controls—5 ton and 10 ton.

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BOILERS

3—150,000 lbs per hour, straight tube, sectional header, 600# w.p., BABCOCK & WILCOX BOILERS.

Also, 500, 750 and 1000 and 2000 H.P. forged steel, Sectional header straight tube water tube boilers. Non condensing turbo generators up to 1500 kw.

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received by November 10th will appear in the December issue, subject to space limitations.
Address copy to the Classified Advertising Division
POWER
330 West 42nd St., New York 36, N. Y.

BOILERS

1—900 HP Springfield sectional header boiler, 400# W. P., 1926, A.S.M.E., Oil Burner equipment, deaerating heater, feed pumps. New Mexico.
2—824 HP Sterling Boilers, 1930, active certificate for 300# W. P. chain grate stokers, ELESCO superheaters, all auxiliaries, Austin, Minn.
2—750 HP, B. and W. Sterling type boilers, 225# W. P., 1925, A.S.M.E., oil firing equipment, all auxiliaries, New Mexico.
2—600 HP, B. and W. longitudinal drum, sectional header boilers, 1922, A.S.M.E. 200# W. P. Peabody oil burners, steel headers, New Jersey.
2—500 HP, B. and W. Boilers, 1916, retubed 1925, 209# W. P. Lawrence, Mass.
1—490# Walsh-Widener Cross Drum, Sectional Headers, 4" tubes, 1927, 450# W. P. all auxiliaries. West Point, Virginia.
1—400 HP Keeler C. P. Boiler, 1942, 160# W. P. new tubes and refractory, TODD mechanical oil burner and pump set. Overhauled, dismantled. Ready to ship. N. Y.

Complete plant consisting of:
2—20,000# pr. hr., 160# W. P., 1942, B. and W. steam generators, deaerating heater, all boiler auxiliaries. A complete plant. San Fernandino, Florida.
2—400 HP, B. and W. sectional header boilers, 200# W.P., steel headers, A.S.M.E., 1921, South Bend, Indiana.
1—310 HP Keeler C. P. Boiler, 160# W. P. 1942, pressure parts ship in one piece. Lake City, Florida.
1—300 HP Keeler C. P. Boiler, 160# W. P., 1942, all auxiliaries. Milton, Pa.

PACKAGE BOILERS

1—400 HP CLEAVER-BROOKS, 150# W. P., 1949, fully automatic, No. 6 oil. N. J.
2—350 HP Preferred Utilities Steam Generators, 200# W.P., 1948, fully automatic, No. 6 oil, Washington, D. C.
Miscellaneous Scotch Marine Boilers, 75 to 150 H.P. available.
A number of Self-Contained & Economic Units, 50-150 H.P., 100-200 Lbs. Pressure.
2—Detroit Roto-Spreader Stokers for 300 H.P. Boilers, nominal rating.
Combustion Engrg., Spreader Stoker complete with fan & Hogan Controls-Stoker. Designed for 600 H.P. boiler at 200% of rating, or 1200 H.P.
3—Elliot Surface Condensers, 1—900 sq. ft. 2—600 sq. ft. Located in New Jersey.
1—500 KW G.E. Turbine, 5 Stage with 625 KVA Alternator, 440 V., 600 sq. ft. Elliot super condenser.
1—300 K.W. Gen. Elec. Turbo-generator set. Completely rebuilt and rewound for 220/440 V. includes switchboard and exciter. Presently boxed for export. Offered at an extremely low price.
1—15 KVA 3/60/220 V. Ideal air commr to 3 cyl. Hill Diesel engine with control panel.

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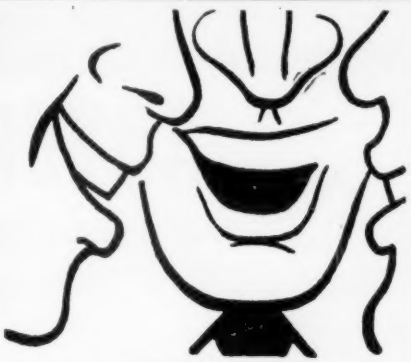

TRANSFORMERS—60 Cycle

Qu.	KVA	Make	Type	Ph	Voltages
1	1500	G.E.	Pyranol	3	4150x2400
1	1000	G.E.	Auto	3	4150x2400
2	750	G.E.	HT	3	4150x120/240
2	750	G.E.	H	1	4600-120/240
1	500	Kuhl.	OISC	1	4150x2400
2	400	Pitts.	OISC	1	4800/4150/2400 x240/480
3	333	Whse.	OISC	1	2400x575
1	333	G.E.	H	1	13200x220 440
2	300	G.E.	H	1	13200x440
4	200	G.E.	H	1	13200x440
1	200	G.E.	HT	3	2400x240
2	150	Pitts.	ODSC	1	240x120/240
3	50	G.E.	H	1	4800x120/240
3	50	A.C.	H	1	230x120/240
1	25	G.E.	H	1	460x120/240
1	20	G.E.	Novalux		2400 6.6 Amps
2	25	G.E.	H	1	575x115/230
3	25	Nlag.	OISC	1	2400x480
3	25	Watchse	SK	1	440/220/110

MOTOR GENERATOR SETS

Qu.	KW	Make	Speed	DC	AC
1	1000	G.E.	514	600	2300/4150 Syn.
1	1000	Whse.	720	600	2300/4150 Syn.
1	1000	Whse.	720	275	2300/4150 Syn.
1	300	C.W.	1200	230	3-unit 2400/4150SR
1	300	G.E.	1200	230	2400/4150SR
1	200	Whse.	900	250	2300/4150 Syn.
1	150	C.W.	1200	230	440 SC
1	150	3 Unit G.E.	1200	125/250	2300 Syn.
1	150	Whse.	600	125	4150 Syn.
1	125	C.W.	1200	125	2300 S.C.
1	100	G.E.	900	250	2300 Syn.
3	60	G.E.	1200	125	208 Syn.
2	30	G.E.	1200	125	440 SC

SYNCHRONOUS MOTORS

Qu.	H.P.	Make	Speed	Type	Volts
1	300	El. Mach.	720	TEFC	2200
3	200	Whse.	720		4150
1	175	G.E.	720	ATI	2300
1	150	G.E.	720	ATI	2300
1	150	G.E.	1800	TS	220
1	150	Whse.	900	181G	220

				Volts
1	150	A.C.	360	440
1	125	El. Mach.	900	4800
1	100	G E	900	2200

SLIP RING MOTORS

Qu.	H.P.	Make	Speed	Type	Volts
2	500	G.E.	1200	M	2400/4150
1	400	Whse.	450	CW	550
1	250	Whse.	600	CW	440
1	200	Whse.	600	CW	440
1	200	G.E.	600	MT	440
3	150	A.C.	1800	AY RW	2300
1	100	G.E.	1800	IM	220
1	100	G.E.	600	IM	440
1	75	G.E.	600	IM	440
1	60	G.E.	1800	MT	220

DC, 230 VOLT MOTORS

Qu.	H.P.	Make	Speed	Type
1	300	G.E.	1200	MPC
2	150	C.W.	900	WP
1	125	G.E.	1700	RC
2	75	C.W.	900	WP
1	30	C.W.	700	CM
1	35	G.E.	860	RC
1	25	Whse.	825	SK

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488 FT. 674 FT. 780 FT.

950 FT. 1317 FT. 1663 FT.

MOTORS 220-440 or 2300 VOLT

STANHOPE, 60 E. 42nd St., N. Y., N. Y.

USED 35 TON BRIDGE CRANE

75' span with 5 ton aux, 25' lift. Cab type 3/60/220 V. A.C.—used approx. 2 yrs. Mfg. Northern—*excellent condition.*

DAVE GORDON STEEL PRODUCTS, INC.

2411 35th St. Tampa, Fla.

P.O. Box 5033 Ph. 4-4169

NEW TRANSFORMERS—25 & 50 KVA

GE, OISC, Distribution Type "H". Form KO2, single ph., 50/60 cyc., 33,000 volts primary, 2400/4160Y, 120/240, 240/480, 600 volts secondary, with 4—2½% taps below 33,000 volts, primary cover mounted bushings, secondary tank-wall mounted bushings. S/N 6,900,000.

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279 CFM 11-10 x 11 Worthington HS—STEAM
294 CFM 10 x 11 Worthington HB, 50 HP Electric
315 CFM Worthington (GAS or DIESEL) Portable
388 CFM Worthington Semi-Portable 75 HP Electric
462 CFM 12-14½ x 13 American AF-S—STEAM
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How to form a "safety belt" for your boiler "TROUBLE ZONE"

Avoid spalled, eroded or cracked boiler walls. Why lose costly hours during shutdowns for repairs? Instead, use special Norton CRYSTOLON* (silicon carbide) refractory shapes for the furnace "Trouble Zone." They form a protective "Safety Belt" that cuts maintenance interruption to a minimum.

Get four-way protection

You can rely on complete boiler wall protection from Norton CRYSTOLON Refractories because they resist the four most common causes of boiler wall failure:

1. **Protect Against High Heat.** CRYSTOLON Refractories withstand temperatures up to 3050°F.
2. **Protect Against Slag Penetration.** CRYSTOLON Refractories are so dense, they're virtually impervious to slag penetration.
3. **Protect Against Clinker Adhesion.** CRYSTOLON Refractories are practically clinker-proof. So rugged that, even if clinkers do adhere to a limited extent, they can be quickly removed without damage to the refractory.
4. **Protect Against Abrasion.** CRYSTOLON Refractories resist abrasion of moving fire beds of stoker-fired furnaces.

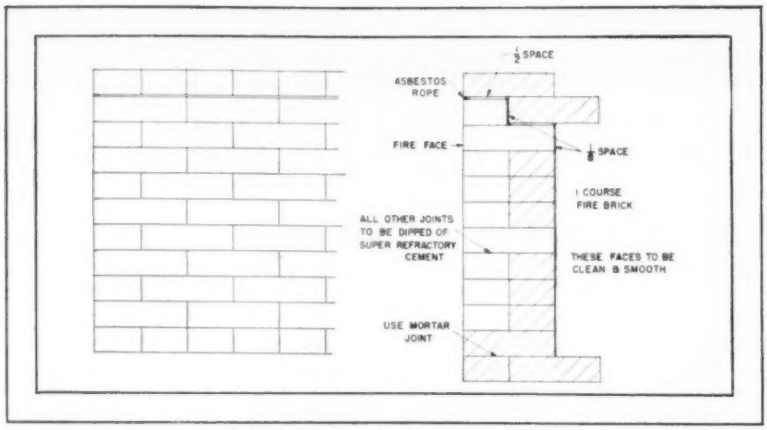
Result, longer life and lower overall costs.

For air-cooled or solid walls

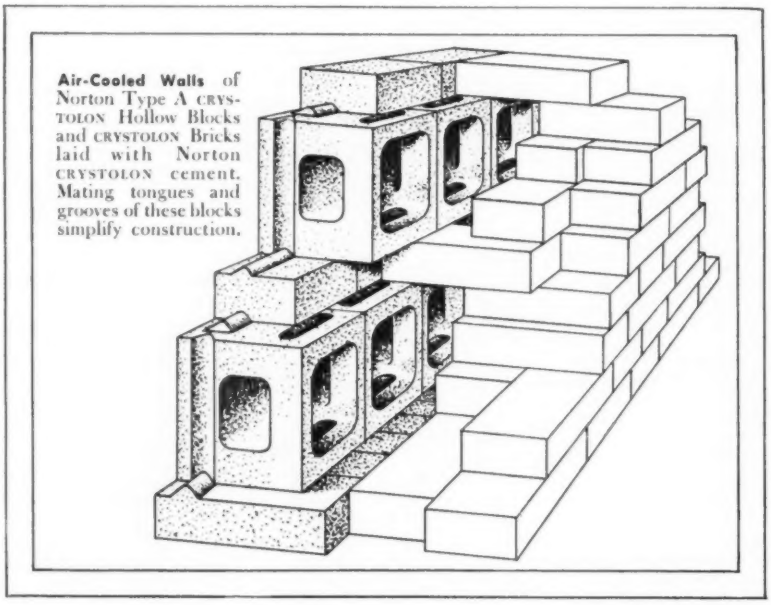
Whether your particular "Trouble Zone" calls for air-cooled or solid walls, you will find a Norton special refractory to fit your particular needs. Both the CRYSTOLON hollow blocks and solid bricks more than compensate for the cost differential between them and ordinary fire brick by their longer service, lower maintenance cost.

You will also find Norton CRYSTOLON* cement highly satisfactory for laying up blocks or bricks. It is a fine-grained CRYSTOLON cement, that matures at very low temperatures, withstands temperatures up to 3050°F and assures a very strong bond.

For further information on Norton refractory brick and cement, ask your Norton representative for Norton Bulletin 862 or write direct to NORTON COMPANY, 450 New Bond St., Worcester 6, Mass. *Canadian Representative:* A. P. Green Fire Brick Co., Ltd., Toronto, Ontario


½ SPACE
ASBESTOS ROPE
FIRE FACE
⅛ SPACE
1 COURSE FIRE BRICK
ALL OTHER JOINTS TO BE DIPPED OF SUPER REFRACTORY CEMENT
THESE FACES TO BE CLEAN & SMOOTH
USE MORTAR JOINT

Solid Wall with up to 9 courses of Norton Company bricks laid with Norton CRYSTOLON cement. For best results, not less than 5 courses of CRYSTOLON brick should be used in any boiler furnace.



Air-Cooled Walls of Norton Type A CRYSTOLON Hollow Blocks and CRYSTOLON Bricks laid with Norton CRYSTOLON cement. Mating tongues and grooves of these blocks simplify construction.

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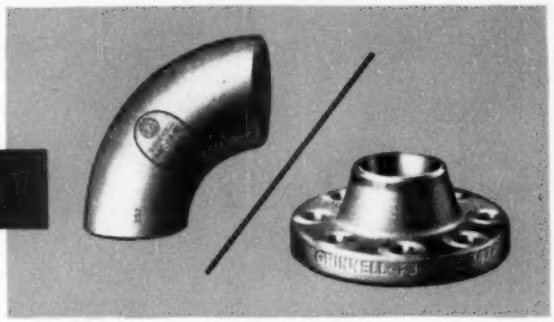

GRINNELL

STAINLESS STEEL WELDING FITTINGS and FLANGES

To help combat mounting costs in the installation and maintenance of piping systems where corrosive or certain other service conditions are involved, Grinnell offers a comprehensive range of welding fittings and flanges in stainless steel.

- **To prevent corrosive attack.**
- **To obtain adequate impact resistance at low temperatures and sufficient creep strength at high temperatures.**
- **To provide sanitary conditions.**
- **To avoid contaminating the product.**

Grinnell welding fittings and flanges are available in types 304, 347 and 316. These are in the chromium-nickel grades known as "18-8". The corrosion resistant properties of stainless steels are primarily due to the chromium content which ranges from 17% to 20%. The addition of nickel in ranges from 7% to 14% improves the corrosion resistance as well as the properties at elevated temperatures. A molybdenum addition of 2% to 3%, as found in type 316, increases the resistance to sulphurous and phosphoric acids, brine and hypochlorite solutions, and improves the general resistance to other corrosive liquids, as well as improving the physical properties at elevated temperatures. A columbium addition of approximately 0.4% to 1.0%, as found in type 347, creates non-susceptibility to carbide precipitation which can cause intergranular corrosion.

In addition to stainless steel, Grinnell offers welding fittings and flanges in carbon steel, nickel, Inconel, Monel, aluminum and brass.

Write for new booklet giving complete data on Grinnell stainless steel welding fittings and flanges. No obligation.

stainless steel welding fittings
Types 304, 347, 316

DESCRIPTION	SCHEDULE†	PIPE SIZE, IN.‡
90° Long Radius Elbow 45° Long Radius Elbow 180° Long Radius Return Straight Tee	5s, 10s, 40s, 80s	½ to 12
Reducing Tee	5s, 10s, 40s, 80s	¾ to 12
Cross (Straight and Reducing)	5s, 10s, 40s, 80s	1¼ to 12
Concentric Reducer Eccentric Reducer	5s, 10s, 40s, 80s	¾ to 12
Lateral (Straight or Reducing)	5s, 10s, 40s, 80s	1 to 12
Cap	5s, 10s, 40s, 80s	½ to 12
Lap Joint Stub End-Long	10s, 40s, 80s	½ to 12
Lap Joint Stub End-Short	5s, 10s, 40s,	½ to 12

† 5s is Featherweight, 10s Lightweight, 40s Standard, 80s Extra Strong.
‡ Larger sizes available on special order.

stainless steel flanges

150 lb. and 300 lb. Steel Flange Standard *(Higher series available on application).*

DESCRIPTION	PIPE SIZE, IN.
Welding Neck Slip-on Lap Joint Threaded Socket Type Blind	½ to 24

150 lb. Corrosion Resistant Standard. *(For use with schedule 10s and 5s pipe. Rated at 150 psi at 500°F, 225 psi at 150°F, when used with full-faced gaskets).*

DESCRIPTION	PIPE SIZE, IN.
Buttwelding Slip-on Blind	½ to 12

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pipe and tube fittings • welding fittings • engineered pipe hangers and supports • Thermolier unit heaters • valves
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hotel's Unexpected Guest . . . proves toughness of Carey insulation

Warm, winter rains in the Sierra Nevada brewed trouble for nearby Reno. They washed the snowpack down the Truckee river, which threads through downtown Reno in a narrow channel. In a few hours, floodwaters surged over the river's banks and inundated most of the city's business district.

At Riverside Hotel, one of Reno's finest resorts, this "unexpected guest" kept Carey-insulated steam lines and heating equipment under water four days.

Today, some three years after the flood, the *same* Carey insulation is doing the *same* efficient job of heat conservation at Riverside Hotel. Only hand-moulded valve fittings and canvas covering needed replacement on hot water and steam lines.

As Riverside's chief engineer put it—"considering the damage we expected, and the abuse the insulation got, it held up remarkably well."

While you may never face flood conditions, you will find it pays to standardize on Carey insulation with *proven* toughness and efficiency. The complete Carey line includes high and low temperature blocks and blankets, pipe insulation, pipe jackets, cements—a Super-Light 85% Magnesia in precision-sized blocks and nesting O. D. pipe coverings you can apply easily and cheaply—remove and reapply when necessary. Get the facts today. Contact your Carey Sales Engineer, or write for latest bulletin "Industrial Insulation," Dept. P-11.

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- Architect: Frank Green, Reno, Nevada
- General Contractor: M. J. Brock & Son, Los Angeles, California
- Heating Contractor: Earl O. Stice, Glendale, California
- Air Conditioning Contractor: Air Conditioning Co. of So. California, Los Angeles, California

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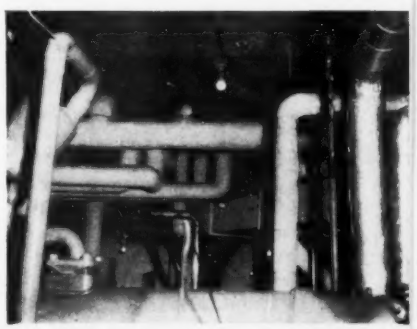
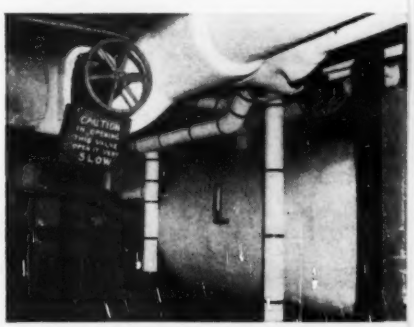
In Canada: The Philip Carey Co., Ltd., Montreal 3, P. Q.



After the flood, canvas covering on Carey insulation was replaced and painted. Fittings for valves were repaired and painted. Shown here are domestic hot water tanks, Freon compressors, steam lines from boilers to hot water heating coils and water lines from deep well pumps for cooling compressors.



Shown here is domestic hot water tank and condensate return pump, main steam line and main steam line shut off valve. Since boilers were returned to operation after the flood, service has been highly satisfactory.

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